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SIR M. VISVESVARAYA

IT is but fitting that a Journal devoted to the cause of science should join in the country-wide celebrations that have taken place this month, of the 81st birthday of one of the most active and effective promoters of the cause of science in India, SIR MOKSHAGUNDAM VISVESVARAYA. His status as an engineer has long been a fact within international cognizance. But more than his acknowledged eminence in that profession, which is undoubtedly the handiwork as well as the handmaid of science, is the urge of the modern progressivist philosophy that has permeated his outlook and activity for half a century and made him a pioneer and an exemplar to administrators and leaders of the public. His extensive travels in Europe and America as well as in Japan enabled him to acquire a first-hand knowledge of the miracles which modern science, and particularly science in the field of engineering, has wrought in the life of man, helping him to raise two ears of corn where only one grew before, to reduce his burden of brute labour, to increase the means of material welfare for all and to bring to every one more leisure, more health and more zest for the pursuit of those cultural and spiritual ideals which make human life a thing worth while. This inspiration was noticeably at work in Sir M. Visvesvaraya over thirty years ago. A high officer of the Bombay Department of Public Works at that time, he had become aware of the noble scientific-industrial idealism of Jamshedji Nusservanji Tata and the project of an all-India institution for scientific research in which that idealism was seeking to express itself; and as a patriotic son of Mysore, Sir Mokshagundam was naturally anxious that his natal State should take a hand in giving concrete shape to that project. Sir M. Visvesvaraya's voice was among the most potent of the influences which worked for the founding of the Indian

Institute of Science in Bangalore. Later on, as the Dewan of Mysore (10th November 1912 to 9th December 1918) it was given to him to give a magnificent impetus to the study and utilization of science in the service of the State. He belongs to that gifted and truly distinguished type of administrator—not too common in any country and very rare indeed in ours—who comes to office borne by the sense of an exalted mission and with a definite programme already waiting in his pocket to be taken out and put into action the moment opportunity arrives. In point of fact, the Mysore Economic Conference, which was a remarkable creation of Sir M. Visvesvaraya's dreams for the country's regeneration through the application of science to agriculture and industry and trade, had been brought into being, mainly as a result of his insistent pleading, when he was the Chief Engineer of the State and had not yet been called to the office of Dewan. The many speeches and statements he made to that organization, and the work of its numerous committees and officers under his guidance, made an impressive contribution to the general awakening of the public as also to the preparing of several important schemes of business enterprise and industrial development. The Krishnaraja Sagara, the Bhadravati Iron Works, the Sandal Oil Factory, the Soap Factory, the Silk Filatures and the University of Mysore,—to mention just a few at random out of a score or more items,—are a standing testimony to the faith of this great man in the beneficent possibilities of science as applied to the problems of human existence. It needed no ordinary amount of courage and firmness on his part to take up the responsibility of setting afoot in those days so many projects involving financial outlay on a scale to which the State had not been accustomed and affecting interests which mere prudence would rather have left unprovoked.

After his retirement from Mysore, he has kept himself incessantly at work to secure the adoption of the help of science to the solution of India's vast economic and social problems. Even a bare enumeration* of his more important reports, pamphlets and speeches will, we have no doubt, suffice to convey an idea of the volume and significance of the work done by Sir M. Visvesvaraya for translating into practical form his deep and unwavering faith in the regenerative and humanitarian office of science. Now at eighty, we find him busy promoting the scheme of an automobile factory, which has been a pet child of his

* 1 "Reconstructing India" (1919).
2 "Technical and Industrial Education in the Bombay Presidency" (1923).
3 "Presidential Address to the 10th Session of the Indian Science Congress, Lucknow" (1923).

for some years, and persuading the Indian Institute of Science, as Chairman of its Court, to adopt a plan of larger and better organised scientific research.

The pages of this Journal are not the place for an examination of the reasons for the comparative unsuccess of some of the causes espoused by Sir M. Visvesvaraya. Such an examination must necessarily take us to fields far beyond the limits we have set to ourselves. But we may just indicate what his own explanation is likely to be. Speaking at a public meeting in Poona in October 1931, Sir M. Visvesvaraya said:—

> "In 1919, in the course of my travels in Japan and the United States of America, I discussed the sterling exchange position in India with recognised financial experts whom I met. The Governor of the Bank of Japan said that the gold standard was the best for this country and he, for one, had no misgivings on the point.
>
> "I pursued my investigation in the United States of America, and it will interest you if I recall a striking incident connected with a visit I paid to a financier and banking expert of repute, Mr. Jacobson by name, who was associated with the Federal Reserve Board at Washington. I went to him with a letter of introduction and had a companion with me who was a New Yorker and a Freemason. I asked the expert what he thought of the sterling exchange position in India and what, in his view, was the best way of placing the currency policy of this country on a sound basis and preventing the losses to which it was being subjected from time to time. He was evidently unwilling, possibly on account of his official position, to speak out his mind, and began to say that India was a distant country, he had not seen it and knew little of its real position and wants. I showed some impatience at this answer, remarking that an expert of his standing could not possibly be so ignorant as he professed himself to be. He thereupon beckoned to my companion into an adjoining room and said: 'Tell this man to go back to his country, change the system of government there and come to me again for advice. I will then be able to help him'. He meant, of course, that the sterling exchange was an adjunct of a *Dependency form of government* and that no advice of his would avail unless the people in India had the power to implement their own policies. The issue of one currency ordinance on 21st September last (1931) and of another three days later to repeal the same has brought home to us, as nothing else could have done, the disabilities under which we labour by being under a Dependency form of government."

Sir M. Visvesvaraya is a man of great courage and strength of will, and never shrinks from the duty of speaking the needed word of truth and justice, whatever the reception it is likely to have from men in power or mere men. The true spirit of science characterises his views on all social questions. Friends of backward and depressed classes in Mysore thankfully acknowledge the help and encouragement he gave to the cause they hold as their own.

A most remarkable trait of his, rather disconcerting to the curious, is his complete avoidance of autobiography. He is not of the sort that wears the heart upon the sleeve. What can be seen of him by us is the man absorbed every moment of his waking hours

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4 "Presidential Address to the Indian Economic Conference, Bombay" (1924).

5 "Indian Economic Enquiry Committee Report" (1925).

6 "Vission of a Prosperous Mysore" (1927).

7 "All-India Swadeshi Exhibition Inaugural Address, Madras" (1931).

8 "Convocation Address to the Andhra University" (1931).

9 "Unemployment in India" (1932).

10 "Rural Reconstruction in India" (1935).

11 "Planned Economy for India—Popular Edition" (1936).

12 "Industrializing India" (1937).

13 "Nation Building" (1937).

14 "District Development Scheme" (1940).

in thinking and feeling and working for the public. Of the personal side of his life and experience, of his trials and struggles and disappointments with men, we get no revelation. He is a generous friend and a delightful host. A convinced supporter of clubs and corporations as nurseries of personal friendships and social felicities and disseminators of new enlightenment and new social and economic programmes, he yet has the art of keeping his soul untouched, "like a star", and "dwelling apart".

Alert in body as in mind, charming in manner, with a lively sparkle in the eyes and a friendly smile always playing round the lips, keenly interested in the affairs of the world, with faith still undiminished in the value of human striving, quick in understanding and stimulating in talk, this veteran patriot embodies in himself the generous dreams and manful aspirations of modern India. Flawless in dress, punctual in keeping engagements, a stickler for method and system in all things, uncompromising in matters of principle, but scrupulously particular not to say or do a thing likely to harm a reputation or wound a susceptibility, he is the very soul of honour and gentlemanliness. It is impossible for any one who has spent a few minutes with him not to come away infected by his enthusiasm for what he considers to be the three basic needs of India—Education, Science and Industry. He who preaches such a gospel and promotes it in all ways open to him is surely entitled to the gratitude of the scientist; and we sincerely tender our cordial and respectful felicitations to Sir M. Visvesvaraya and wish him many many years of strength and happiness for the continued service of science, and through it, of India and humanity.

—(*Contributed*)

PALÆOBOTANY IN INDIA

WE have recently received a copy of the Second Annual Report for the year 1940 on the progress of palæobotanical research in India published in Lucknow under the editorship of Prof. Birbal Sahni, and a perusal of its contents reveals the increasingly large volume of work being done in different parts of India in the field of palæobotany. As one would expect, most of this work is carried out in Lucknow, where an enthusiastic band of workers under the inspiring leadership of Prof. Sahni have been making most valuable contributions to our knowledge of Indian fossil floras. Of these special mention may be made of the paper by Mrs. Jacob (formerly Miss C. Virkki) on the "Spores from the Lower Gondwanas of India and Australia" which is a comprehensive work throwing light not only on the climatic relations of the early Glossopteris flora, but also on the possible use of these spores in Gondwana stratigraphy. Among the other subjects investigated in Lucknow may be noted (*i*) the Triassic flora from the Salt Range, and the Jurassic plants from Afghan-Turkistan by Mr. R. V. Sitholey, (*ii*) the Rajamahal flora by Dr. K. Jacob and Dr. A. R. Rao, (*iii*) the flora of the Deccan inter-trappean series in the Nagpur-Chhindwara area by Professor Sahni and Dr. H. S. Rao, and (*iv*) the fossil plants from the upper Karewas (Pleistocene) of Kashmir, by Mr. G. S. Puri.

The study of fossil algæ from the Cretaceous and Eocene rocks of India is being pursued in Bangalore where Messrs. S. R. Narayana Rao and K. Sripada Rao have been making important contributions to our knowledge of the algal flora in these beds from Rajahmundry, N.-W. Frontier Province, Sind and Surat.

Annual reports of the kind now under review are sure to be of great value in directing and stimulating further research.

A HYPOTHESIS AS TO THE ORIGIN OF COSMIC RAYS AND THE EXPERIMENTAL TESTING OF IT IN INDIA AND ELSEWHERE

BY

R. A. MILLIKAN, H. V. NEHER AND W. H. PICKERING

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THE hypothesis here adopted as to the mode of origin of the cosmic rays makes possible the prediction of five definite vertically-incoming cosmic-ray bands. As the observer moves north from the magnetic equator each of these five bands should begin to reach the earth at a particular latitude and continue reaching it at all more northerly latitudes. Between each latitude of first entrance of a band of particular energy and the latitude of first entrance of the band of next lower energy there should be found a plateau of constant vertically-incoming cosmic ray energy. Four such plateaus should be experimentally observable.

The hypothesis rendering possible these predictions rests upon five major discoveries made by the workers in the Norman Bridge Laboratory of Physics at the California Institute of Technology at Pasadena. These discoveries are: (1) that more than 60 per cent. of all incoming cosmic ray energy is of the nature of incoming charged-particle bullets (either electronic or protonic), each of energy between 2 billion electron-volts and 15 billion electron-volts; (2) Neddermeyer and Anderson's discovery of the production by nuclear impacts within the atmosphere of mesotrons which serve as the chief carriers of the cosmic ray energy down to the lower levels of the atmosphere; (3) Bowen's remarkable discovery that atoms, when out in interstellar space are able to undergo atomic transformations forbidden to them within the stars, and (4) Bowen and Wise's discovery that in ring-nebulæ, trillions of miles away from the exciting star, and therefore presumably reflecting conditions in interstellar space, there are five of the atoms, namely, helium, carbon, nitrogen, oxygen and silicon, each of which is more than ten times more abundant than any other atom save hydrogen (which must be excluded from measurable cosmic ray effects because of the smallness of its rest-mass energy); and (5) Lauritzen and Fowler's discovery in the Kellogg Radiation Laboratory that a part at least of the rest-mass energy of an atom has the power under suitable conditions of transforming itself directly into the creation of a positive-negative charged-particle pair.

The hypothesis made in view of these five discoveries is that, while the evolution of energy by the stars is maintained, as Bethe has recently shown, by the *partial* transformation within the stars of the rest-mass energy of hydrogen into radiant energy through the building of helium, carbon and other atoms out of hydrogen, and the release through this process of the so-called "packing-fraction" energy, the energy of cosmic rays on the other hand is maintained, by the occasional *complete* transformation in interstellar space of the rest-mass energy of the atoms of helium, carbon, nitrogen, oxygen, and silicon (and even heavier aggregates), into cosmic rays, each such event presumably creating either an electron pair or a proton pair (these two events are indistinguishable by our

geographic experiments), though an occasional proton pair, or neutron pair, need not *necessarily* be excluded.

The foregoing hypothesis requires that the cosmic rays of measurable energy reveal a spectral distribution of five distinct, definitely measurable bands as follows: (1) a band of rays each having an energy of 1·9 billion electron-volts produced by the annihilation, or complete transformation, in interstellar space, of the rest-mass energy of the helium atom; (2) a carbon-atom-annihilation band of energy 5·6 billion electron-volts (b.e.v.); (3) a nitrogen atom band of energy 6·6 b.e.v.; (4) an oxygen atom band of energy 7·5 b.e.v.; and (5) a silicon atom band of energy 13·2 b.e.v.

The hypothesis requires further that there should be in India, for vertically incoming rays, between the magnetic equator and magnetic latitude about 20 degrees N. a plateau of unchanging cosmic ray intensity with latitude; it requires another such plateau between the latitudes of entrance of the bands due to the silicon and oxygen atoms; it requires a third such plateau between the great band produced by the annihilation of the carbon, nitrogen and oxygen atoms, and that due to the annihilation of helium; and finally it requires a fourth such plateau north of Bismarck, North Dakota, where as the observer goes northward, the helium band should first be able to get vertically through the blocking effect of the earth's magnetic field and should then be able to enter the earth in full strength at all more northerly latitudes.

The experimental evidence that has been so far obtained in India and elsewhere for the existence of these five bands and four plateaus may be thus summarised. The India evidence seems to be good for the existence of the plateau of constant cosmic ray intensity from the equator up to Agra (17° N.) and for the appearance just north of Agra of a band that can be identified with that due to silicon. There is some evidence for the existence of the flat plateau just north of the latitude of first entrance of the hypothetical silicon band. There is unambiguous evidence for the entrance at about the computed latitude of a very strong band at between 5·5 and 7·5 b.e.v., and this we tentatively identify with the joint carbon, nitrogen, oxygen bands which, however, we have not yet been able to resolve. There is a little evidence for the existence of a plateau of constant cosmic ray intensity between the latitudes at which the carbon and the helium bands should appear, and there is fair evidence, too, for the existence of a flat plateau north of the latitude of entrance of the hypothetical helium band, the real existence of which may be stated to have been rendered probable. Not only are all the predicted latitudes in reasonable agreement with the observations, but also the observed intensities are of the right order of magnitude.

Further experiments are being made to see whether better designed apparatus will render the nature of the evidence better or worse for the hypothesis and new experiments in Mexico and the United States are planned for the coming months.

This comparison of prediction and experiment has been made possible largely through the generous support of the investigation by the Carnegie Corporation of New York and the Carnegie Institution of Washington. The success of the work in India was made possible by the extraordinarily generous and complete co-operation of the British Indian Meteorological Service.

ON THE ORIGIN AND DEVELOPMENT OF SILVER COINAGE IN INDIA*

BY

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ON July 22, 1941, I received from the Director-General of Archæology in India the eleven (actually 12) silver pieces illustrated and described here. The question that I was expected to answer was whether these were the predecessors of the later punch-marked silver coins. One glance at the weights showed that, taken as a group, they could not possibly be such predecessors, except in so far as any historically earlier bit of precious metal precedes any later one. But I was particularly intrigued by the cuneiform marks on No. 9, and asked Rao Bahadur K. N. Dikshit whether he or any of his experts had noticed anything special about that piece. In answer, he sent me a copy of his report made on the very date of his discovery, whereof the relevant portion is appended here: "1st January, 1926:—The most important discovery during this year's excavations was made on the morning of the New Year's Day when underneath a wall running east and west in the trench between sites B and C was discovered a silver vase (No. Dk. 1341) complete with lid containing jewellery, square and circular silver pieces. One of these is inscribed in cuneiform characters, thus connecting once for all, the period of the last city on this site roughly with the cuneiform world. As it is well known, the Babylonians had no regular coins but used lumps of silver and gold of definite standards known as Mana or Shekele. In the 8th Mandala of Rig Veda, Indra is asked to bring Manas of gold (Hiranyaya Mana) which conclusively proves the use of these forms of weight in India at the time when the Aryans came. The find of these rectangular and round silver pieces (the precursors of punch-marked coins of later times) with cuneiform signs is therefore of the highest importance for settling the chronology of Indian history."

My own comment on these views will appear later on. But I cannot refrain from expressing surprise and regret that this report was not made public by the authorities to whom it was submitted. The annual report for 1925–26,[1] rewritten by Mr. Ernest Mackay, states, "The find is so important that it deserves to be described in detail"[1] (89), but omits all mention of the cuneiform punches on No. 9; the vase itself is shown on Plate XLIIIc, and the contents on Plate XLII, with the piece in question shown at the bottom, though the cuneiform marks cannot be discerned clearly (due presumably to the angle of incidence of the light). No mention whatsoever has been made of the piece or of the marks on it in the imposing tomes of Marshall[2] and Mackay[3] on the subject, which is curious in view of the fact that Mackay was specially brought in as "an archæologist from outside with a first-hand knowledge of prehistoric excavations in Sumer and Western Asia"[2] (13).

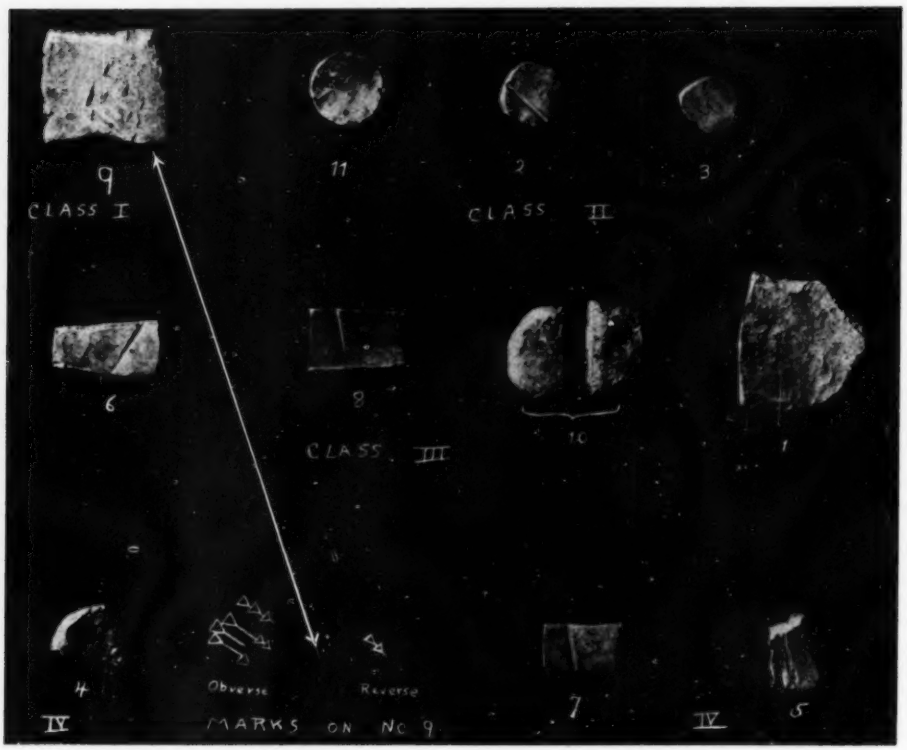
The pieces sent to me fall into no less than four classes, best described separately. With the exception of the cuneiform, on No. 9, the rest only bear "incisions", which are merely chisel marks. Such of the pieces as have been cut off from larger bits are undoubtedly cut by the process of hammering on a cold chisel and then breaking off at the mark by force; the resulting fracture shows an edge that is partly smooth and partly rough. Thus the "incisions" are trial marks, perhaps marks of the end of the chisel when making other cuts.

CLASS I. No. 9 (23·4010 gm.)—The piece has been cut off at both ends by chiselling and breaking off from a larger cast silver ingot. The process of cutting described above characterizes currency in the earliest times, and still survives in some

* The views expressed in this note are entirely my own and should not be taken as implicating or representing in any way the Archæological Survey of India or any of its officials. The weights of the pieces given here are as from my own observations, which differ little from the weights as taken at the Central Asian Antiquities Museum, Delhi, with one exception where the error is as much as one gram. The pieces are all "under field register No. Dk. 1341, except No. 10 which bears No. Dk. 6129, and No. 11 which bears No. 11337".

parts of the world. In parts of Burma, at least till 1897, it was the custom to take along a metal ingot when out shopping, and cut off suitable pieces to approximate weight as small change.[14] The pieces then continued to have their own independent existence.

followed the course of all coinage in debasement and lightening. The *shekel* of Josephus is about 210 grains, which is almost exactly the Mohenjo-Daro weight that amounts to four times the *kārṣāpaṇa* weight of our punch-marked coins. But this is probably insignificant, because the



Silver Pieces found at Mohenjo-Daro in 1926

Assyrian inscriptions mention "sealed" *minas* and *shekels* from the time of Sennacherib onwards, and these are taken by archæologists to be cast roundels, which might have resembled our Class II here. Our piece seems to be too light to be a *mina*, and is too heavy for any *shekel* within my knowledge. It is to be noted that the standards of weight varied; an accurate study, particularly of hoard material, might enable us to date the piece according to its weight-standard. The Assyrian *zuzu* continued to be known in early Christian times as a round coin of very small value, having earlier *shekel* (= 1/3000 talent) whether Attic or Hebrew, was heavier.

The inscription on the reverse is most probably to be read as *gam* or *gur* ([4] No. 206; [5] No. 318; [6] No. 344) taken horizontally, with less probability, it would be sign No. 2, *ḫal*. The meaning is not clear when the sign stands by itself, but here it might indicate "to pour forth", perhaps the casting of the original ingot. The larger ideogram on the obverse would certainly have been taken as a mark of denomination or a numeral sign, but for the fact that three of the wedges are long. Even now it

is difficult to see what else it could indicate in view of the fact that all the wedges point in the same direction without a single cross or *u* wedge. The nearest signs to it are the *in* of Elamite inscriptions at Behistūn, and *dugud* [Barton[5] (401)]; it is certainly neither of these. I hope expert Assyriologists will forgive my amateur efforts, as also the fact that I am unable to see anything special in the signs that might permit us to date the find. The "cuneiform world" endured from at least 2500 B.C. to the Persian Empire; and we know that Alexander's conquest and the supersession of the Empire by the Seleucids did not end the use of cuneiform, inasmuch as an inscription of Antiochus Soter (280 B.C.) has been found in quite good Assyrian. Not only that, the "letters of the Ammunneer" of Philo Byblius probably refer to the Ras Shamra alphabet and would indicate that there existed people who could read cuneiform writing in very much later times, though the full bloom of the Assyrian language begins about 1400 B.C.

The primary importance of the piece, then, derives from the obvious conclusion that it was imported from the West, presumably Mesopotamia, in the way of trade. Silver deposits are not known in India within reach of the Indus Valley; it would seem likely in view of the Indus seals found in Mesopotamia that all the Indus silver was imported thence in payment for other commodities. The piece under discussion and other pieces of the find show us that we are, before the last city on the Mohenjo-Daro site, already at the beginning of a rough coinage system. A late Sanskrit word for such a cut and broken piece of silver or gold might be *kanakabhaṅgaḥ*, which is found in our lexica. But, along with the silver, the coinage system is also imported so far, because the pieces, *except Class IV*, do not conform to the general standard of weights found at Mohenjo-Daro and Harappa.

In some respects it might be possible to go further than this. There are many who assert that an intimate connection between Sanskrit and the cuneiform script must have existed, because Sanskrit is yet a "syllabic" language, our alphabets still bearing the consequent marks of intricacy; as with the cuneiform ideograms, a single Sanskrit word can mean a large number of ideologically unconnected things. Some have attempted to trace Assyrian roots and names in the Vedas, attempts originating in as well as hampered by the authors' lack of mastery over one or (as in my case) of both the languages concerned, and their disregard for the fact that we are at the dawn of modern language structure, in an age when language itself was one of mankind's rare instruments. It would, however, be possible to admit that in the very first line of the Rigveda the root *il* occurs which can be connected with the Assyrian *ilu* = god. And the cuneiform determinative *ilu* can also be read as *an*, which is the name of one of our ancient deities. But all this need not be relevant here because the root can also be taken as Dravidian, and even to-day the Brahui language is a Dravidian survival far to the north, surrounded entirely by Aryan languages. The Aryans who succeeded, perhaps ruined, the Mohenjo-Daro culture could have had their contact directly with the Assyrians in Asia Minor or Mesopotamia, as witness the Mitanni inscriptions, and the Asuras mentioned so often in the Vedas. By this, the Asura Vipracitti would be a Hittite, as citti(m) = hittim (Hebrew) seems to be a permissible equation. The Assyrian word for silver ka-as-pu might have left the Sanskrit root *kās* or *kaṣ*, to shine.

As I have said, there is no evidence that these speculations are to the point when dealing with Mohenjo-Daro.* The question might be raised, however, whether the cuneiform marks could not have been made in India. Certainly, there has been found one seal, at Ur itself, which is definitely of the Indus type but bears cuneiform marks in place of the usual linear Indus script[2] (406, 413). The evidence before us at most allows us to expect that there were some people in the Indus basin, whether indigenous or immigrants, who might know how to use cuneiform, but it could never have been a common script in India. The Sanskrit for a cuneiform seal, punch, or ideogram would be *kīlamudrā*, which is not to be found in the dictionaries, though it might conceivably occur in some obscure tantric work; Lüders,[7] however, has pointed out that the Prakrit equivalent does occur in the Niya Kharoṣṭhī

* The war has made it impossible to communicate with the leading Assyriologists. It would have been most helpful, for example, to be able to consult Hrozný's reported decipherment of proto-Hittite inscriptions on Indus seals.[8]

tablets, where he takes it to indicate the sealed wedge-shaped documents themselves. Two Assyrian clay tablets of about the sixth century B.C. relating to the sale of two women were found in a Bombay store-room;[8] the provenance being unknown, these are probably to be taken as modern imports from some tourist's acquisition at a Mesopotamian site. Pran Nath[9] reads a wedge as *ni* on a punch-marked coin in the Thorburn collection, but this too seems doubtful to me. The one find comparable to that described here is the pot-inscription published by C. L. Fábri[10] as a Sumero-Babylonian pre-cuneiform label. But even here, the reading was contested by Heras[11] who preferred to read the complementary area on the pot itself as being typical Indus writing. So, we have before us the first, and at present the only, known cuneiform and definitely Mesopotamian writing in ancient India.

CLASS *II*.—This consists of three round pieces which have really nothing in common but their shape; they form no system of weight, and as each is manufactured by a different process, it is doubtful whether they represent coinage. There is just a chance that they were meant to find their way into a jewellery pattern, which need not, however, conflict with their interim use as coins No. 3 (2·2177 gm.) has been flattened out from a cold silver pellet or other smaller piece by means of hammer blows of considerable force, as is seen from the cracks that have developed at the edges, and the appearance of the surface. No. 11 (2·9353 gm.) is of very bright silver, but has a patch of brown lacquer-like coating that prevents a thorough examination. From its shape and general appearance, it must have been cast to size and then lightly worked over. No. 2 (4·3108 gm.) has been trimmed from a larger silver plate, the corners being neatly rounded off. The only mark it bears is the common chisel-mark or incision.

CLASS III.—This can be taken, roughly, to form a system, though the system cannot be associated clearly with any known Indus weights. The basis might, at best, be connected with the Paila coins, about which I have not at present sufficient information for a definite statement; if the coins now in the Lucknow Museum become available for study at some later date, the point could be settled. The nearest pieces in this group are too heavy for the Taxilan "long-bar" coins. It must be kept in mind that the standard is only roughly followed; but it would seem to be a foreign standard so far as can be judged from the evidence. No. 6 (2·8867 gm.) is cut and broken off from a thin plate, rather like the later punch-marked coins in appearance, but too light for the kārṣāpaṇa. The sole mark is a chisel mark on the face. No. 8 (5·8353 gm.) is similarly manufactured, but with only one rough edge, one chisel mark on face. No. 10 actually happens to be two pieces made by cutting a round, fairly neat, well-filed piece almost exactly in two with a blunt cold-chisel. It is described as "broken", on the DGA's containing envelope. This might denote completion of the fracture after excavation, but the original intention of cutting the piece in two is in any case obvious. It is also clear that whoever did the cutting had had plenty of practice, inasmuch as the two pieces weigh 5·9039, 6·0720 gm.; an excellent dichotomy, considering the bluntness of the tool. Finally, No. 1 (19·4787 gm.) is apparently half of a still bigger piece, the cut edge having been made smooth. The system of weights is apparently on the scale of 1, 2, 2 + 2, the last being close to seven units, which does not coincide with the dual Indus system of increasing weights. Perhaps, the last piece should not be included here at all.

CLASS IV.—These three pieces are weighed on the Indus system, and if there be any "precursors" of the punch-marked coins in the pieces sent to me, they can only be these. These are all from one find (Dk. 1341), seem unfitted for use as jewelry without further shaping, and the weights belong approximately to the Indus Class D, being: No. 4 = 3·3576 gm., No. 7 = 3·7025 gm., No. 5 = 3·9282 gm. The first is a sector from a round piece, the second from a plate cut off after several trial attempts; the third also trimmed from a plate, but with one edge probably circular in the source. The fact that claims our attention here is that these are significantly cruder (by the z test) than the Mohenjo-Daro Class D weights or earlier Taxilan kārṣāpaṇas; and also significantly heavier than both by the t test. There are two interpretations possible: that the pieces represent purchases of silver to an approximate Class D weight; or that they were to be smoothed down at a later date to the precise weight, having had a little

margin left and in fact as little margin as possible with fairly clumsy cutting tools. If the latter explanation is accepted, the conclusion must also be taken that we are already beginning to see bits of a precious metal trimmed to a standard weight, hence the beginning of a coinage system. In any case, the coinage that came later must have originated in some such way, if this be not its immediate origin.

The later developments are quite clear. Even after the destruction of Mohenjo-Daro, which is entirely a trade city as shown by its fine weights and poor weapons, the traders persisted, and continued to use the very accurate weights of that period. The first marks were traders' marks, such as are seen on Persian sigloi, and the reverse of the punch-marked coins of the pre-Mauryan age. This is shown clearly by one coin published by the late Babu Durgā Prasād.[12] This coin is blank on one side like our Mohenjo-Daro pieces, but the other contains no less than thirteen small marks, similar in type to those known as the later "reverse" marks. For the earlier Taxila hoard I have established these marks[13] as having been regularly placed in time, with a loss of about 0·2 grain weight per mark. Moreover, the newest coinage of the earlier Taxila hoard, B.E.2, shows that if a single standard prevailed for those coins, it must have been almost exactly 54 grains at the time of issue. So, Durgā Prasād's coin, weighing (according to him; I have not been able to check the weight) 105·75 grains would have been worn down from the 108 grains double-kārṣāpāṇa, particularly as the central one of the 13 marks seems to me to be an issue mark.

My contention is that the manufacture of coins continued to be the traders' function for a long time after the Indus period; that the small marks were put on according to a system generally understood at the time by those who handled the coins most frequently. It follows from my previous work that the traders (or the Vaiśya caste) were very accurate in their workmanship, and gave good value.

At a *later* period but not later than the sixth century B.C., the Kṣatriya steps in as the king who claims the royal prerogative of stamping his own marks on the coins. The punch-marked coins then begin to have larger obverse marks, usually five in number (four for the Paila coins), and are issued with a blank reverse. The Mohenjo-Daro accuracy still persists, the trader still continues to stamp on his own small reverse marks as per his own checking system, till the Mauryan period. This ushers in coins characterized by the crescent-on-arches mark on the obverse, and the system of traders' reverse marks disappears very soon, being replaced by a single large reverse mark, such as the "Taxila mark", or some other characteristically Mauryan stamp. The superb accuracy of the weighing is also lost, and the coins have much more copper than before. Some of my critics wonder at this cruder technique, which seems unlikely to them in view of the *Arthaśāstra* and the fine sculpture, architecture, epigraphy of the Mauryan era. I prefer to form my judgment from the coins themselves. As a matter of fact, the present year in India is certainly not inferior in productive technique to any of its predecessors; but, due to pressure of increased trade and a corresponding increase of the need for coinage, along with a certain amount of hoarding caused by the war, the new rupees will be found inferior in minting to the older ones. At least, they contain more copper (an increase from $^1/_{12}$ to $\frac{1}{2}$), and the varience at the time of minting[15] is, to the best of my knowledge, much greater for the George VI than for Victoria, Edward VII, or George V rupees. The parallel explanation is undoubtedly that the Mauryan conquests opened up entirely new regions; the old, limited, slow, cumbrous trading system between India and Mesopotamia must have vanished against the pressure of a rapidly increasing volume of trade in the new areas opened up in the south. At any rate, the primitive tumuli, the pāṇḍukulīs, of the southern part of the peninsula survived so late as to contain coins of Augustus, not to speak of our punch-marked coins. Not only that, in such southern hoards as I have been able to study, the proportion of Mauryan coins is very large[16] some hoards of over a thousand coins apparently consisting entirely of punch-marked coins of the later Mauryan period or their imitations. This can mean only one thing: that coinage as such was virtually unknown in the south of India before the Mauryans. In the north, we rarely get a Mauryan hoard of any considerable size unmixed with pre-Mauryan coins. The later Taxila hoard of 168 coins is purely Mauryan (excepting one coin of Diodotos),

though so crude in fabric as to be suspected as a forgery; and all but five coins are in mint condition, which indicates some unusual circumstance attending the deposit.

Thereafter, we come to the period of cast coins, which nevertheless retain some of the earlier marks. Local and transient weight systems also develop, and the unifying influence of the trader is entirely lost, probably because of the development of large kingdoms at war with each other, each with its own provincial culture and language. Indian numismatics thereafter becomes a branch of epigraphy.

Nevertheless, in closing this note, I wish to point out the necessity of studying *hoards* of coinage as a whole and for every period if we are to reconstruct the lost economic and political history of our country from our unusually meagre and conflicting records. For example, from a study of the earlier Taxila hoard, I have been able to show that the Taxilans enjoyed comparative economic stability for at least sixteen and probably twenty indictions, say two centuries or more. But a great deal more can be said from the mere structure of the hoard. Of its 1175 coins, 1059 were exactly of the type found further east with maximum density at or near the ancient Magadhan Kingdom; 79 were minute coins, the small change of the day, and might have been local; as also the 33 "long-bar" coins, not found in Magadha, which are close to being double-sigloi. Just four more coins were found in the hoard: two of Alexander, one of Philip Arrhidaios, and an unidentifiable Daric (siglos). This shows quite clearly that Taxila belonged to the Indian, Magadhan, economic sphere at a time when it is supposed to have been a part of the Persian Empire, or at least in the Persian political sphere, since the conquests made by Darius I. The balance of trade, moreover, was in favour of Taxila, the coefficient of survival for currency being ·71 for the currency so regularly imported from the east. Therefore, after Alexander's invasion had swept away the stronger tribes of the Punjab that acted as buffer states, a Magadhan conquest of Taxila was inevitable. Therewith must have followed the doubtful status of a frontier dependency to replace what had essentially been a center of exchange between two vast trade regions, and the Taxilan economic advantage must have been lost. This would explain the revolts that are referred to as having occurred at Taxila, one of which A s o k a[17]—apparently—had to quell as viceroy; and the speedy ruin of Taxila following the Mauryan conquest. But without the hoard material, we must always remain in doubt as to the true significance of our literary sources. Just as a race has to be studied by taking a fairly large sample of its representatives, so also the coins left by a vanished age must be studied by looking at their weight and chemical composition *in a group*. A single coin is just about as representative of the culture as a single individual of the race.

I am grateful for Dr. S. M. Katre's revision of the proof.

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[1] Archæological Survey of India, *Annual Report*, 1925–26, pp. 72–98.

[2] John Marshall, Editor, *Mohenjo-Daro and the Indus Civilization*, London, 1931, 3 vols.

[3] E. J. H. Mackay, *Further Excavations at Mohenjo-Daro*.

[4] J. Rosenberg, *Assyrische Sprachlehre u. Keilschriftkunde*, 2nd ed.

[5] G. A. Barton, *The Origin and Development of Babylonian Writing*, Part II, Leipzig and Baltimore, 1913.

[6] G. Howardy, *Clavis Cuneorum*, London, Leipzig, Kopenhagen, 1933.

[7] H. Lüders, *Die Śākischen Mūra*. Sitzb. Preuss. Akad. Wiss., 1919, Phil.-Hist. Klasse, pp. 734–66, particularly p. 742.

[8] Tablets at the Bhandarkar, O. R. Institute. See *JAOS*, 1920, **40**, 142–144.

[9] Pran Nath, *Indian Historical Quarterly*, 1931, **7**, Supplement, 14.

[10] C. L. Fábri, *Indian Culture*, 1936–37, **3**, 663, 673, plate.

[11] H. Heras, *Indian Historical Quarterly*, 1937, **13**, 697–703.

[12] Durgā Prasād, *Journal of the Asiatic Society of Bengal*, 1935, Numismatic Supplement No. **45**, 13, Plate 7.

[13] D. D. Kosambi, *New Indian Antiquary*, **4**, 1941.

[14] R. C. Temple, *Indian Antiquary*, 1897, **26**, 160–162, *et al.*

[15] My own observations show that the variance of the George VI (1940) rupees is not less than that of George V rupees twenty-three years in circulation, *i.e.*, of the order of three to four times the former minting variance. The legal remedy seems to have been relaxed to more than twice its former value of 1/200.

[16] From a letter of Dr. K. N. Puri, this seems also to hold for his Rairh finds in Jaipur State.

[17] *Divyāvadāna*, (ed. Cowell and Neil), p. 371 seq.

RESEARCH WORKERS AND THE PATENT SYSTEM*

II. WHAT IS PATENTABLE?

BY

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(The Patent Office, Calcutta)

"ORIGINALITY" may be said to be a *sine qua non* for enjoying protection under the patent system. But every achievement of human effort where originality has been displayed is not capable of being protected by means of patents. Patents are granted for 'inventions' only, and the term 'invention' may be defined as 'any manner of new manufacture'. It is obvious from this definition that patentable subject-matter should possess 'novelty' and should be essentially a 'manufacture'. It has, however, been held by the courts that anything which is a 'manufacture' and which has 'novelty' is not necessarily a 'manner of new manufacture' and that in order to fall within the scope of the latter expression the subject-matter should necessarily be the outcome of 'inventive ingenuity'.

In this article, an attempt is made to give concrete ideas underlying the expressions 'novelty', 'manufacture', and 'inventive ingenuity', as they are understood in patent law.

(i) *What is 'novelty'?*

The significance of the expression 'novelty' will now be considered. In patent law 'novelty' is not understood in its strict etymological sense, and does not imply the state of being never known before. The patent laws of various countries have laid down different standards of novelty requisite for the grant of patents within their jurisdiction. The scope of this article, however, will be confined to the requirements of the British Patent System, on which the patent laws of this country are based.

The 'novelty' of an invention is invariably considered with reference to what constitutes 'public knowledge within the realm'. It has therefore to be judged from the territorial as well as the "public knowledge" aspects.

The origin of the territorial aspect of 'novelty' may be traced to the early days of the patent system, when artificers from abroad were encouraged to settle down in England and introduce new manufacture within the realm, by the grant to them of monopolies in respect of such manufactures. Due to this territorial aspect of 'novelty', it is now possible to obtain patents for inventions which, though already in existence abroad, are new within the realm.

The real significance of the 'public knowledge' aspect seems to have been not fully appreciated by those engaged in research, as, in many cases, inventors have failed to enjoy patent protection on account of their utter disregard of the principles underlying it. The subject therefore deserves more than a passing reference, and will be dealt with at some length in this article.

Now, one of the cardinal principles of the modern patent system is that under no circumstances must a patent interfere with the rights of an individual to make use of any manufacturing processes or apparatus which has come to his knowledge, unless the right to the exclusive use of such process or apparatus has been previously reserved by someone else. In the ordinary course, he may obtain this knowledge by seeing the process or apparatus actually at work in a factory or in a show-room, or at a demonstration or at an exhibition; or he may obtain it by reading a description of the process or apparatus in a publication, or by hearing an account thereof by way of lectures. The information which is thus made available to the public before it is

* The views contained in this article reflect the views of the author only and do not represent those of the Government of India and should not be taken as committing the Government of India in any way.

protected by applying for a patent for it, is taken as being unconditionally dedicated for general public use, and as such, cannot thereafter be monopolised by anyone, including the author of the information. This principle, however, is completely disregarded by many scientific workers in various ways, some of which are briefly referred to in the succeeding paragraphs.

For example, a large class of inventors are under an impression that for establishing their prior claim to inventorship, they should publish an account of their researches in scientific journals, at the earliest possible opportunity. They seem to forget for the time being that the patent system not only provides them with an equally well recognised means of establishing their priority, but has the added advantage of retaining their proprietary rights over their inventions. By rushing to the press in the first instance, they lose once for all their proprietary rights over the invention published, because the moment an invention is published without applying for a patent for it, it becomes the property of the public. Inventors of this class should therefore remember that even if they are anxious to establish their priority of inventorship, it is advisable for them to file their patent applications at least simultaneously with the publication of their inventions in the scientific journals, if not before such publication.

These remarks apply with equal force to the publication of inventions that takes place through the reading of papers before learned societies, or through the delivering of popular lectures, or through demonstrations at exhibitions. Wherever such publication takes place before steps are taken for the protection of the inventions concerned, the said inventions become thereafter a part of the stock of public knowledge and even the inventors will not be allowed to interfere with the rights of free use of the invention by the public.

It is recognised, however, that considerable time will be taken up for making a proper application for a patent and that the exigencies of the circumstances may demand an immediate publication of the inventions made by scientific research workers. To meet such a situation, a special provision is made in the Indian Patents and Designs Act, *vide* Section 40, by which inventors are allowed to publish their inventions at exhibitions or before learned societies, even before making a proper application for a patent, provided they pay a small fee of Rs. 5 and send a brief description of their invention to the Patent Office. By adopting this simple course, inventors could proceed with early publication of their invention at exhibitions or before learned societies, without prejudicing their right for filing a proper application for a patent after such publication.

Some inventors who are in need of financial backing for the exploitation of their inventions often find it necessary to explain the working of their inventions to the potential financiers, and very often they do so without enjoining any promise of secrecy. These inventors ignore that the financiers who come into the possession of the full knowledge of such inventions in such circumstances, can, if they choose, make use of the inventions without any recompense to the original inventors. Even where such a disclosure takes place in a confidential manner, the inventors very often find it extremely difficult to establish that the disclosure was made confidentially. It is therefore best not to disclose the invention to others except after filing an application for a patent; but where this is unavoidable, inventors should take particular care to have at least some documentary evidence of the secret nature of the disclosure made to the financiers.

The same precaution should be taken where, at the experimental stage, it becomes necessary to disclose the invention to mechanics and technicians whose services may be engaged for completing the invention.

Another danger to the novelty of an invention may arise from the fact that it was developed in a workshop or a factory where other employees who are not bound to secrecy had ample opportunities to obtain a knowledge of the invention. In such cases, these other employees would be at liberty to disclose the invention to rival manufacturers or to make use of the invention for their own benefit to such an extent as to constitute a bar to the grant of the patent to the inventor. The only safeguard against this danger is either to work out the experiments secretly or to adopt a system of binding all employees to a bond of secrecy.

The foregoing paragraphs illustrate how owing to a lack of proper appreciation of the "public knowledge" aspect of "novelty", the inventors themselves destroy the novelty of their inventions. Cases in which the responsibility for the public knowledge of the invention does not fall on the inventors, are also deserving notice, because an invention which has become publicly known, whether through the inventor or through any other source, would be thereafter not "novel". In this connection, it should be noted that an important source of public knowledge of inventions in this country is the patent literature available at the Patent Office at Calcutta.

Abridgements of thousands of specifications of patents granted in the United Kingdom, U.S.A. and Australia, and also the publications of the Indian Patent Office, are available for inspection in the public room of the Patent Office, and any invention which is described in any of these documents is deemed to have lost its novelty. Applicants for patents very often argue that their inventions were made by them independently, or that what is described in the aforesaid patent literature, is not actually "in practical use" in British India, and that the mere fact that a paper anticipation of the invention was available at the Patent Office, should not be a valid ground for refusing the grant of a patent for their invention. It is therefore worthwhile to repeat here that individual inventive merit involved in an invention is not the sole criterion for the grant of a patent, but the novelty of the invention with reference to what already constitutes 'public knowledge' has an equally important bearing on the question.

It is also noticed that research workers realise only too late that the ordinary technical literature which is consulted by them in connection with their researches contains but a small fraction of the inventions disclosed to the public through the patent literature mentioned above. The importance of consulting the patent literature before undertaking elaborate investigations cannot therefore be overemphasised, as, the omission to do so might lead merely to the rediscovery of what was previously invented by others.

It is also necessary to refer here to the special case whereby even the secret use of an invention imposes a disability on the inventor as regards its patentability. This is contained in Section 38 of the Indian Patents and Designs Act which provides that an invention shall not be deemed a new invention if the inventor has not by secret or experimental user made substantial profits from his invention. Due to this provision an inventor cannot, by resorting to secrecy in the first instance, hope to enjoy a monopoly for his invention for a period over and above that which would be available to anyone who comes for a legal protection under the patent system. This serves also as an additional inducement to the inventor to apply for his patent as soon as he completes his invention, without keeping it back from the public with a view to work it in secrecy.

The practical aspects of "novelty" may therefore be summed up as follows:—

(1) before undertaking researches of practical utility, research workers should in the first instance, study the patent literature available on the subject;

(2) as far as possible, the results of researches should not be disclosed to others before taking proper steps to protect the inventor's right;

(3) if, however, it becomes absolutely necessary to disclose the inventions to contractors, capitalists or co-workers, even before applying for the patent, care should be taken to enjoin secrecy; and where possible, evidence should be created of the confidential nature of the disclosure; and

(4) if there is an idea of patenting an invention, the invention should not be worked for profit before applying for a patent therefor.

LETTERS TO THE EDITOR

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REACTION BETWEEN ETHYL IODIDE AND COPPER SALTS

DURING our investigations on the catalytic effects of various salts on the kinetics of the persulphate-alkyl-iodide reaction,[1] we observed that copper salts accelerated the reaction to a great extent. This anomaly could not be explained. Now, it has been found that there is a reaction taking place between copper salts and ethyl iodide even in the absence of the persulphate, liberating free iodine and hence the abnormally high results are obtained in the persulphate-alkyl-iodide reaction catalysed by copper salts.

This action of copper salts on ethyl iodide can be compared with the action of mercuric and silver salts on alkyl halides.[2] These two ions, silver and mercuric, have a great affinity for the halide ion, which may be due to the small ionisation of the mercuric halides, to the insolubility of the silver halides, or to the fact that silver halides dissolve in excess of halide ion forming complexes of the nature of AgI_2^-. It may be possible that other ions which form moderately stable complex halide ions like copper may also bring about similar reactions with alkyl halides.[3] This deduction led us to investigate the action of copper salts on alkyl halides.

We have found that the progress of the reaction can be followed by the ordinary iodometric method, after extracting the iodine with benzene. Such extraction of iodine is necessary on account of the deep colour of copper salts which mask the colour of iodine, making a direct titration against standard thiosulphate solution impossible.

The reaction has been found to be kinetically of the first order, with respect to the alkyl iodide. The probable mechanism of the reaction may be a preliminary dissociation of the alkyl halide into free radicals (a unimolecular process) followed by faster reactions involving copper ions and iodine ions or radicals as in the persulphate-alkyl-iodide reaction.[4] Further details regarding this will be published later on.

V. D. TASKAR.
M. S. TELANG.
V. V. NADKARNY.

Ramnarain Ruia College, and
St. Xavier's College,
Bombay,
May 12, 1941.

[1] Telang and Nadkarny, *J. Indian Chem. Soc.*, 1939, **16**, 536.
[2] Burke and Donnan, *J. Chem. Soc.*, 1904, **85**, 555.
[3] Hammett, *Physical Organic Chemistry*, 1940, 138.
[4] Telang and Nadkarny, *Curr. Sci.*, 1940, **9**, 226.

A SENSITIVE TEST FOR THE DETECTION OF ARGEMONE OIL

RECENT investigations, specially of R. B. Lal and co-workers, incriminating argemone oil as the factor responsible for the production of epidemic dropsy, have naturally aroused considerable interest. The present author pointed out some anomalies of this theory and also reported that a sample of mustard oil prepared in a special way from mustard seeds free from those of *Argemone mexicana* was positive to so-called physical and chemical tests for epidemiologically incriminated mustard oil. The nitric acid test which has been used so long for qualitative and quantitative purposes is far from satisfactory since it is not at all a specific test for argemone oil and is given by a large number of other substances.

It has now been possible to develop a very simple and sensitive test for argemone oil. This will enable us to detect the presence of argemone oil in mustard oil up to a concentration of 1 per cent. and can be conveniently used as a routine procedure.

The test may be carried out by heating in a water-bath 2 c.c. of the suspected oil with concentrated hydrochloric acid, ethyl alcohol and ferric chloride solution when an orange-red precipitate will be formed in the lower acid layer or may be collected at the acid-oil interface. If the conditions are favourable this precipitate may be converted into beautiful orange-red fibrous crystals.

The importance of this test lies in the fact that three proved potent (dropsy-positive) samples of mustard oil are negative to this test showing that *the samples do not contain argemone oil even in the concentration of* 1 *per cent.* There is another peculiarity of this test. In the case of the proved potent mustard oils, the oily layer turns deep black while it is faintly tinted, if at all, in the case of fresh and pure 'ghanni' mustard oil. There are indications that this test may be used to detect impure mustard oil. Full details will be presented elsewhere.

I may add that these tests have been kindly verified by Prof. S. N. Bose, F.N.I., to whom my best thanks are due.

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August 25, 1941.

AN IMPROVED VOLUMETRIC METHOD FOR THE ESTIMATION OF URIC ACID

Two disadvantages of the usual titrimetric procedure,[1] for the estimation of uric acid in urine are (*a*) the tedious necessity to wash the precipitate free from chlorides and (*b*) the absence of a clear end-point with permanganate. Ceric sulphate overcomes both these defects in that (*a*) the reagent can be used in high concentrations of chloride,[2,3] thus obviating the necessity for washing the precipitate chloride-free and (*b*) an exceedingly sharp end point is obtained with *o*-phenanthroline-ferrous complex indicator.[4,5]

Theoretical values having been obtained with pure solutions, and with synthetic urines containing known amounts of uric acid, the method finally adopted for the determination is as follows:—

A suitable aliquot is pipetted into a centrifuge tube, sufficient ammonium chloride added to make the salt concentration 20%, and dissolved by gentle stirring if necessary. Strong ammonia (1 c.c. of sp. gr. 0·88 for 10 c.c. liquid) is now added, the contents thoroughly mixed, and set aside for two hours. The precipitate is then centrifuged, the supernatant liquid decanted off and the sides of the tube well drained. It is then washed with a saturated solution of ammonium chloride containing ammonia (5 c.c. of sp. gr. 0·88 for 100 c.c.), and afterwards taken up in 1 : 1 HCl (10 c.c.) treated with sulphuric acid (5 c.c. 1 : 1), and an excess of 0·02 N ceric sulphate, as indicated by a persistent light yellow colour of the mixture. The contents are diluted to about 100 c.c. making the final concentration

0·5–1·0 N in sulphuric acid, and the excess of ceric sulphate titrated with 0·01 N ferrous ammonium sulphate (connected to a microburette over alkaline pyrogallol), using o-phenanthroline indicator. Just before use this indicator is oxidised to the neutral point (purple) with ceric sulphate, and two drops of the neutralised indicator are used for each titration.[6] The uric acid content is calculated from the quantity of ceric sulphate used up, 1 c.c. of 0·02 N ceric sulphate corresponding to 1·68 mgm. uric acid.

The recovery of added uric acid in 3 samples of urine by this method were as follows:—

Uric acid content of urine	Uric acid added	Uric acid found
mg.	mg.	mg.
19·59	5·00	24·53
20·73	10·00	30·52
21·91	25·00	45·94

The stability of ceric sulphate in dilute solutions considerably enhances the usefulness of the method. With slight modifications it can also be adapted to the estimation of uric acid in avian excrement and similar biological materials rich in uric acid. Full details of these procedures will be published elsewhere.

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Department of Biochemistry,
Indian Institute of Science,
Bangalore,
June 17, 1941.

[1] *Practical Physiological Chemistry*, Cole, S. W., 1933, 9th Edn., p. 326.
[2] *J. A. C. S.*, 1928, **50**, 1322.
[3] *J. Chem. Educ.*, 1934, **11**, 466.
[4] *J. A. C. S.*, 1931, **53**, 3908.
[5] *Ibid.*, 1933, **55**, 3260.
[6] *Jour. Biol. Chem.*, 1938, **123**, 199.

TOP-ROT ('TWISTED TOP' OR 'POKKAH BONG') OF SUGARCANE, SORGHUM AND CUMBU

Top-rot or 'pokkah bong' of sugarcane is prevalent in Java, Australia, Louisiana and Hawaii (Martin, 1938)[1] and has also been recorded from India (Subramaniam, 1936).[3] During the year 1940, the same disease was noticed in South India at Kulitalai in May and at Coimbatore in December. In both the places the disease broke out after the rains. The spindle was distorted and the shortened leaves were rolled into whiplike structures. Reddish brown patches were present on the sheaths and base of blades and the tissues were torn. The end of the whip had turned brown and rotted. In extreme cases the terminal portion of the stem also rotted. The discoloured portions on incubation produced growths of *Fusarium moniliforme* Sheld.

A 'twisted top' disease of sorghum was for the first time observed in October 1939, on the Central Agricultural Station, Coimbatore. The affected plants had the upper leaves linked together forming arches. The tips of the younger leaves were rolled inside those of the older ones. This process was repeated until most of the leaves of the plant formed a series of arches one over the other on one side of the plant. The upper nodes were shortened and usually the earheads were not produced (Fig. 1). The rolled tips were brown and in moist weather a growth of fungus was seen on the surface. The disease was again noted in November-December 1940. On all these occasions it was observed only after the rainy weather. The rolled tips produced on incubation growths of *F. moniliforme*.

In July 1940, a similar disease was noticed on cumbu (*Pennisetum typhoides*) at Coimbatore. The plants were stunted and the top leaves were shortened, twisted and rolled into one another. No earhead was developed (Fig. 2). The blade of some of the leaves had dwindled down and what was left was brown and split up. The rolled portions had partly

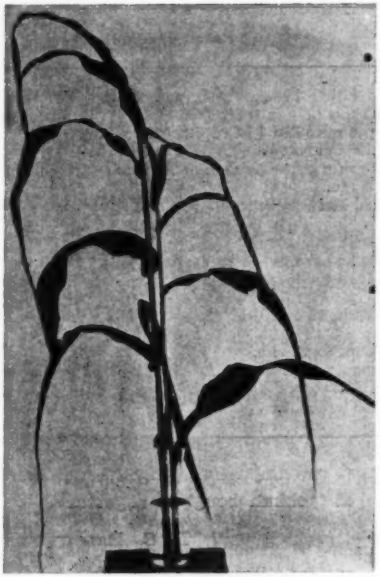

FIG. 1

Symptoms of the disease on sorghum

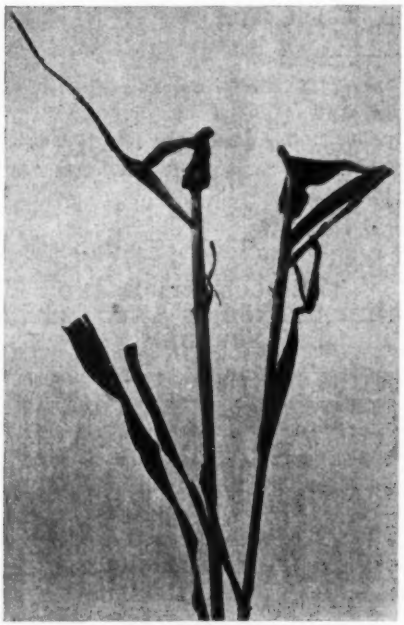

FIG. 2

Symptoms of the disease on cumbu

turned brown and rotted. *F. moniliforme* was isolated from the diseased portions.

The three isolates of *F. moniliforme* were grown on french-bean and quaker oats agars and steamed rice. On french-bean agar all the three isolates produced white mealy growths. The growths are more profuse and light cream coloured on quaker oats. The medium is coloured light purple, the depth of the colour being most with the sorghum, less with the sugarcane and least with the cumbu isolates. All of them make very good growth on steamed rice. The grains turn purple, the sorghum strain producing dark purple pigmentation and the others lighter purple.

The pathogenicity of the isolates was tested by inoculation of different host plants. Spore suspensions were poured down the spindle and the plants were placed inside glass cages kept moist by spraying water twice a day. The results were as shown in the table following.

Suitable controls were kept and they remained healthy.

It can be seen from the results of the infection experiments that the three isolates of fungi bring about the death of their respective host plants in the young stage but on older plants the effect is not always fatal and more time is taken for infection. The sorghum and sugarcane isolates exhibit a greater pathogenic ability than the cumbu isolate. All the isolates gradually lose their virulence the longer they remain on culture media.

All the three isolates were inoculated on rice of the Gobikar variety. The grains were placed in spore suspensions under an exhaust pump for five minutes and then left for soaking for 24 hours. Afterwards the grains were sown in seedling pans containing sterilised soil. The seedlings remained healthy in all the pans thereby showing that none of the isolates is parasitic on Gobikar—a variety susceptible to 'foot-rot' caused by *F. moniliforme*.

Under field conditions the diseases on sorghum and cumbu have not been observed to be very extensive nor are the host plants

Source of isolate	Host inoculated	Result
Sorghum ..	Sorghum plants 1 month old	All plants killed in one week and fungus developed on central shoots.
	„ 2 months old	Central shoot rotted in 15 to 18 days.
	Sugarcane shoots 1 month old	Shoots killed and rotted in 20 days.
	„ 2½ months old	Reddish brown patches formed and tissues torn at the base of the blade.
	Cumbu plants 1 month old	Plants killed in 15 days.
Sugarcane ..	Sorghum plants 1 month old	The plants died and shoots rotted in 12 days.
	Sugarcane shoots 1 month old	Shoots killed and rotted in 15 days.
	„ 3 months old	Unfolding leaves with red brown patches and split at these places. No death.
	Cumbu plants 1 month old	Plants killed in 12 to 15 days.
Cumbu ..	Sorghum plants 1 month old	Central shoots discoloured and killed in 15 days.
	Sugarcane shoots 1½ months old	Reddish brown patches formed at the base of the unfolding leaves in 12 days. No death.
	Cumbu plants 1 month old	Plants killed in 10 days.

usually killed. The disease becomes evident only during and after the rains and it is arrested on the advent of bright weather. The affected plants occur often in groups. A disease having symptoms similar to those of the sorghum disease described above has been noted on sugarcane in Cuba and is called 'twisted top' (Priode, 1929).[2] But it is said to be caused by mechanical friction of the leaves. The colour of the affected leaves is however stated to be similar to that of healthy leaves and there are no indications of rotting. Moreover it is said to be more severe during extremely dry periods. On the other hand, the diseases on sorghum and cumbu are accompanied by a certain amount of discolouration and rotting of leaves and occur only during the rainy months being absent during the dry season. Furthermore *F. moniliforme* has been always isolated from the discoloured portions of the leaves. The local disease of sorghum is hence different from the non-parasitic twisted tops of sugarcane in Cuba and is akin to the 'pokkah bong' of sugarcane caused by *F. moniliforme*. The fungus affects the leaves in the earlier stages which prevents their natural unfolding and the terminal portions of the leaves that come out later do not become freed but get entangled resulting in the series of arches. In cumbu the symptoms are more like those of 'pokkah bong' of sugarcane.

T. S. Ramakrishnan.

Agricultural College and
Research Institute,
Coimbatore,
July 14, 1941.

[1] Martin, J. P., *Hawaii Sugarcane Planters' Association*, 1938.

[2] Priode, C. N., *Phytopathology*, 1929, **19**, 343.

[3] Subramaniam, L. S., *I. C. A. R.*, 1936, *Bulletin*, No. 10.

THE OCCURRENCE AND INHERITANCE OF A BLOOMLESS SORGHUM

It has been recorded in a previous paper that all sorghums develop a waxy bloom and that the heavy bloomed condition (gene H) is a simple dominant to the sparse bloomed condition[1] (gene h). An examination of recent additions to the world collection of sorghums at the Millets Breeding Station, Coimbatore, showed that an African variety from Tanganyika by name *Vigage* (M.B.S. No. A.S. 4572)

belonging to the *Sorghum elegans* group was bloomless. In the least manifestation of the bloom the de-sheathed internode will show a little bloom. But A.S. 4572 was absolutely bloomless.

This rare type was crossed with both heavy bloomed and sparse bloomed types. In the former cross the F_1 was heavy bloomed and in the F_2, 252 plants were heavy bloomed and 84 absolutely bloomless. In the latter cross also the F_1 was heavy bloomed but the F_2 gave 108 heavy bloomed, 35 sparse bloomed and 43 bloomless plants, giving a 9 : 3 : 4 ratio. From this family 17 selections were carried forward and their performance is given below:

Family No.	Character of selection	F_3 behaviour		
		Heavy bloom	Sparse bloom	No bloom
A. S. 6752	No bloom	..	..	Pure
A. S. 6753	,,	..	..	Pure
A. S. 6754	,,	..	..	Pure
A. S. 6755	,,	..	..	Pure
A. S. 6749	Sparse bloom	..	Pure	..
A. S. 6751	,,	..	Pure	..
A. S. 6748	,,	..	93	36
A. S. 6750	,,	..	52	17
A. S. 6744	Heavy bloom	Pure	..	..
A. S. 6740	,,	99	34	..
A. S. 6745	,,	38	13	..
A. S. 6739	,,	77	..	26
A. S. 6741	,,	81	..	31
A. S. 6742	,,	97	..	32
A. S. 6746	,,	52	..	18
A. S. 6743	,,	69	21	29
A. S. 6747	,,	40	15	20

From the above table it will be seen that a gene designated Bm is responsible for the production of bloom in sorghum; bm gives an absolutely bloomless condition where the gene H has no visible expression. Seven selections in the above F_3 segregated for pithy and juicy stalks[2] also (genes D and d) and a cross collation showed an independent inheritance for bloom and for stalk juiciness genes. The total of the above segregations was, bloom-pithy 417, bloom-juicy 133, bloomless-pithy 141, and bloomless-juicy 50.

G. N. Rangaswami Ayyangar.
B. W. X. Ponnaiya.

Millets Breeding Station,
Coimbatore,
August 8, 1941.

[1] *Proc. Ind. Acad. Sci.*, 1937, **5**, 4–15.
[2] *Madras Agric. J.*, 1936, **24**, 247–48.

THE OCCURRENCE AND INHERITANCE OF SHOOTS FROM THE AXILS OF PANICLE BRANCHES IN *SORGHUM SUDANENSE*

The rare occurrence of the e-ligulate and non-auriculate condition in the leaves of sorghum has been recorded. This has been noted to be a monogenic recessive to the normal ligulate and auriculate condition of the leaves. Non-auriculate plants lack the cushiony pulvinus at the base of the panicle branches.[1]

This note records an interesting sequel to the abnormal condition of e-ligulateness. In one e-ligulate type of *Sorghum sudanense* from Russia it was found that every panicle had side-shoots with two to three leaves and occasionally with tiny terminal panicles from the axils of panicle branches (see photograph). All the progeny exhibited this peculiarity in two successive generations. This type was crossed with a ligulate normal panicled type. The hybrid was ligulate and normal. In the F_2, no dihybrid ratios were obtained, there being only 229 normal ligulate plants and 74 e-ligulate plants with axillary shoots in the

Side shoots from the axils of panicle branches in *Sorghum sudanense*

panicle. An F_3 generation was raised and in it, the three segregating families gave the following figures.

Selection No.	Character of selection	F_3 Behaviour			
		Ligulate		e-ligulate	
		No axillary shoots	Axillary shoots	No axillary shoots	Axillary shoots
S. 328	Ligulate no axiuary shoots	30	1	..	12
S. 329	,,	57	..	1	17
S. 330	,,	73	..	1	22
	TOTAL .	160	1	2	51

From the above table it will be seen that there is a close linkage between the factor for e-ligulateness and the factor stimulating axillary shoots in panicles, there being a crossover value of about 0·01 per cent. It is interesting to note that in plants in which these shoots developed from the panicle axils, the axillary buds of the stem also were stimulated and gave many side-shoots. This teratological phenomenon has proved heritable.

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August 8, 1941.

[1] *Proc. Ind. Acad. Sci.*, 1938, **7**, 286–88.

TWO NEW GENES CONDITIONING THE TINT OF THE COLOUR ON THE GLUMES OF SORGHUM

THE glumes of sorghum are reddish purple, blackish purple or brown. Factors P and Q operate and give these three groups. The leaf-sheaths take on the same colour as the glumes.[1] A study of the vast collection of sorghums at the Millets Breeding Station, Coimbatore, reveals many tints on their glumes. Most of the tints remained constant in the progeny and it was obvious that there were other genes in addition to P and Q which were responsible for the tints. With a view to know more about these tints *Sorghum dochna* group was chosen as it exhibited a wealth of tints. In this group the glumes are very coriaceous with the added advantage of prominence due to the grain being almost enclosed and to the absence of transverse wrinkling. Most of the varieties of *S. dochna* have loose panicles and the spikelets get the best chance of exposure to light. The glumes are also very smooth and shiny and for these reasons the glumes of *S. dochna* afford the best theatre for the optimum manifestation of pigment on sorghum spikelets.

Two new types of purple on the mature glumes have been found and these have been termed "Dilute reddish purple" and "Dilute blackish purple" and are brought about by a single dilution gene. In a cross between a dilute reddish purple and a blackish purple type the F_1 was reddish purple. The F_2 generation gave 69 plants with the deeper tint (51 reddish purple, 18 blackish purple) and 20 plants with the dilute tint (16 dilute

reddish purple, 4 dilute blackish purple). In the F_3 generation the 4 dilute tinted selections bred true and of the 12 deep tinted ones 5 were pure. The remaining 7 segregated again giving a total of 883 deep and 277 dilute tinted plants. In 5 families there was also a segregation for reddish and blackish purple tints (genes Q and q); the total of the dihybrid ratio in these being 503 reddish purple, 172 blackish purple, 156 dilute reddish purple and 56 dilute blackish purple. Thus it will be seen that the gene for the dilution of colour in the glume (designated cd) is found to be independent of the gene Q. This gene dilutes the colour on the sheath also but not to the same degree as that on the glume.

Sorghum panicles with Bleached and Unbleached glumes

The second gene inhibits the manifestation of the colour on the body of the glume and confines it to the very base. On a close examination, faint patches of colour may be noticed on the body of the glume but the total effect is one of bleaching (see photograph). The effect of the bleaching gene is noticed only after the dough stage of the grain. The colour instead of deepening does not develop but remains as a narrow band at the very base of the glume only. Thus even with the inhibition it is possible with experience, to separate reddish purple, blackish purple and brown groups with the aid of the basal band.

In a cross between two *S. dochna* types one bleached and the other unbleached, the F_1 generation had bleached glumes. The F_2 segregated giving 106 plants with bleached glumes and 35 plants with unbleached glumes. Sixteen selections were carried forward and an F_3 generation raised. Of these 3 bleached glumes bred true and 6 segregated giving a total of 559 plants with bleached glumes and 188 with unbleached glumes. The remaining seven unbleached glume selections bred true.

From the above it will be seen that a dominant gene Ci is responsible for the inhibition of colour and the bleached appearance of the glumes in sorghum. The gene has no effect on the leaf-sheath colour. The gene R responsible for the red sap colour in sorghum[2] has its effect on the appearance of the bleached glumes also. With R, the bleached glume puts on a pinkish wash.

It will be seen that in addition to P and Q genes, (responsible for reddish and blackish purple) two new genes cd (dilution gene) and Ci (bleaching gene) affect the tint of colour on the glumes of sorghum. The many possible combinations of these genes provide a variety of glume tints. These are again affected by the gene R determining the red in sap colour. The numerous glume colours enumerated by Snowden[3] in the classification of sorghums could be explained against this genic background.

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Coimbatore,
August 8, 1941.

[1] *Ind. Jour. Agric. Sci.*, 1933, **3**, 489–94.

[2] *Madras Agric. J.*, 1934, **22**, 1–11.

[3] Snowden, J. D., 1936, *The Cultivated Races of Sorghum*.

KERNELS OF *THEVETIA NERIIFOLIA* JUSS.—A POTENT INSECTICIDE

INVESTIGATIONS were recently started at the Entomological Laboratory, Agricultural College and Research Institute, Coimbatore, to determine whether indigenous vegetable poisons could subserve as potent insecticides as well. The existence of contact insecticidal properties of a high order in the seeds of *Thevetia neriifolia* Juss. has come to light. Aqueous infusions were found to be toxic against insects infesting plants. These were prepared by soaking mashed kernels in water for 24 hours and filtering the extract. It was then sprayed with the addition of an equal quantity of soft soap. Trials against caterpillar pests such as *Prodenia litura* F., *Papilio demoleus* L., *Deilephila nerii* L., *Spodoptera mauritia* B., *Laphygma exigua* H.B., *Eupterote mollifera* W., *Euproctis* sp., etc., and bugs of different species of Aphids, Tingids and Psillids have given very satisfactory results. The optimum concentration for getting a high mortality in most of these insects would appear to be ¼ to ½ oz. of the kernel in one gallon of water (0·16% to 0·31%). Mealy bugs like *Pseudococcus virgatus* C. and hard-boiled scales like *Saissetia nigra* N. however, require higher concentrations varying from one to two ounces per gallon. With the added advantage of its cheapness and easy availability, this vegetable poison is bound to prove an important source of a very effective insecticide. Further studies are in progress.

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August 30, 1941.

GENETICAL STUDIES OF ERI SILKWORMS—(*ATTACUS RICINI* BOISD)

IN a consignment of live Eri silkworms received from the Silk Farm, Coonoor, two different types of worms were met with. While both were similar in size, colour, position of setæ, etc., one had prominent black spots on the body (Fig. 2) while in the other the black spots were absent (Fig. 1). To find out whether this variation was brought about by differences in sexes the two types of caterpillars were sorted out, fed separately and allowed to pupate. When the moths emerged both sexes were found in both the groups and they were phenotypically alike. Their breeding behaviour was then observed. Eventually moths from the

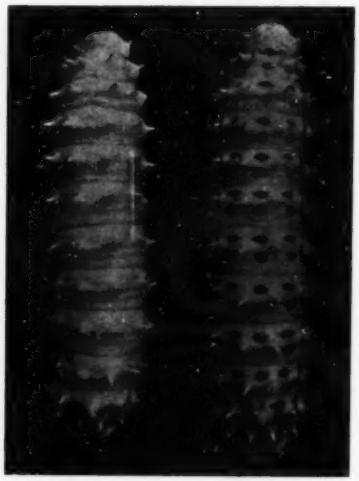

FIG. 1 FIG. 2.

'spotted' were crossed with those from the 'non-spotted'. F.1s were all spotted. In the F.2s spotted and non-spotted segregated in a simple monohybrid ratio (245 : 84). This was further confirmed by the results obtained by back crossing the F.1 with the recessive (177 : 162). It was concluded that spotted character in Eri silkworms is controlled by a simple pair of Mendelian factors (S, s) spottedness behaving dominant.

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Coimbatore,
August 30, 1941.

EFFECT OF STORAGE ON THE QUALITY OF PONGAMIA OIL

THE solid deposit from pongamia oil was reported to contain zinc salts of higher fatty acids and practically all the karanjin of the oil.[1, 2] Experiments regarding the origin of the zinc and the conditions promoting the precipitation of karanjin have subsequently been made and the results are presented here.

A careful examination of the oil, of the seed cake and of the seed showed that no zinc was present in them. Obviously, therefore, it should have come from outside and the container should have been responsible for it. In our previous experiments it happened to be made of galvanized iron and we presume that the case was similar with the experiments of Manjunath and Rao. In a recent communication,[3] Jones and Haller have reported the presence of zinc in stored products and have isolated the zinc compound of bi-eugenol from commercial geraniol. With a view to make the position sure, samples of freshly-expressed pongamia oil were stored under similar conditions in glass bottles and in galvanized iron containers. In the first case even after five months there was no deposit whereas in the second case appreciable quantities were obtained even within a month and the bulk of the deposit increased rapidly with time. It was further noticed that within the first two months the solid consisted mostly of zinc salts and only later on the precipitation of karanjin took place. It seems to be clear, therefore, that the hydrolysis of the fatty oil is initiated and enhanced by the presence of zinc and that it is the first step in the changes taking place. The liberated acids combine with zinc to form the zinc salts and also cause the precipitation of karanjin. The last point was established by working with the oil present in glass containers and adding small quantities of glacial acetic acid. Karanjin began to separate in the course of a few hours and was complete in a few days. The precipitation was considerably enhanced by keeping the oil cooled in ice and shaking occasionally. With 3 per cent. addition of acetic acid, about 3 days was found to be enough for the separation of most of the karanjin. The substance was quite pure and unmixed with any solid fatty acid. It could therefore be concluded that it is necessary to store the oil in glass containers in order to avoid rapid deterioration in quality and if quick separation of karanjin is desired, addition of an organic acid like acetic acid would be very helpful.

N. V. SUBBA RAO.
T. R. SESHADRI.

Andhra University,
Waltair,
August 15, 1941.

[1] Manjunath and Rao, *J. I. C. S.*, 1938, **25**, 653.

[2] N. V. S. Rao and T. R. Seshadri, *Curr. Sci.*, 1940, **9**, 76.

[3] Jones and Haller, *J. A. C. S.*, 1940, **62**, 2558.

A MARGOSA TREE WITHOUT THE BITTER PRINCIPLE

IN a note appearing in a recent number of *Current Science*[1] Mr. Cherian Jacob has described an extremely interesting association of a margosa and banyan tree, in which the bitter principle of the margosa has been found lacking. The reasons adduced by the author to explain this phenomenon are untenable. The terms 'stock', 'scion' and 'grafting' have been used in a rather loose way. While there is no record of any vascular connection in epiphytes with the host tissues, it is difficult to determine the stock and scion in independently rooted plants. If the banyan tree could draw out the bitter principle, it would indeed be interesting to know whether the banyan leaves developed the bitter principle in them.

In this connection the writer wishes to mention that margosa trees without the bitter principle have been known to occur in many places. A margosa tree near Mandya, Mysore State, is an object of worship on account of

the fact that in one of the branches overhanging the walls of a temple, the leaves are devoid of the bitter principle, while the rest of the tree bears bitter leaves. This margosa tree is not found in association with banyan or any other plant.

It is quite manifest that the absence of the bitter principle is due to some changes other than the 'stock' influence of the banyan. The author mentions that it is not a genetic modification because the seedlings had leaves with the bitter principle. It would have been more convincing if observations were made in plants propagated from clones.

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Department of Botany,
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August 19, 1941.

[1] *Curr. Sci.*, 1941, **10**, 335.

I WAS much interested to learn of the occurrence, in Mandya, of a margosa tree, in which one particular branch bears leaves devoid of the bitter principle.

My object in publishing the note in the July number of *Current Science* was only to bring to the notice of the workers, about the existence of an interesting tree combination. I suggested that the banyan tree might have originally started as an epiphyte and later by the peculiar circumstances of growth described in the note, there is every reason to believe that some parts at least of the two trees might have fused, and the banyan being now a much bigger tree might be influencing the margosa. I did not examine any section to find out whether there is any real fusion. I leave that for future workers. I do admit that the terms, stock and scion, have not been used in the scientific sense of the terms; they were used more with a view to connote the union of the two trees. It would certainly be interesting to study the behaviour of the seedlings raised from the seeds of the parent margosa tree. But I have no doubt that the seedlings found under the banyan-margosa tree combination are from the seeds of this margosa tree.

The suggestion I have made in my original note will stand, until definite evidence to the contrary is forthcoming. A critical examination of the Mandya tree and also of other trees without the bitter principle occurring "in many places" will undoubtedly be of much interest. When I was touring in Chingleput District in the Madras Province it was brought to my notice that a mango tree within the precinct of the Conjeevaram temple bears different kinds of fruits on the four sides of the tree. I examined the plant in question and found that the so-called single tree was the combination of at least two different varieties planted close to each other and now appear to have only one main stem.

K. CHERIAN JACOB.

Agricultural Research Laboratory,
Lawley Road P.O.,
Coimbatore,
September 3, 1941.

REVIEWS

Temperature—Its Measurement and Control in Science and Industry. (Reinhold Publishing Co., New York), 1941. Pp. xiii + 1362. Price $11.00.

The first statement of the Foreword that "This book is the record of a 'Symposium on Temperature—Its measurements and control in Science and Industry' held .... under the auspices of the American Institute of Physics" .... perhaps represents the best review of the work. As a matter of fact it can hardly be described as a "book", for neither has it been written in that form nor does the subject-matter covered lends itself to be treated in a book form of the conventional type. It is simply a collection of papers embodying the results of numerous investigations presented at the symposium, and as such forms an excellent reference volume on the subject of temperature control and measurements in diverse fields including theoretical and experimental physics, applied and industrial chemistry, engineering and metallurgy, natural sciences, biology and physiology, etc., etc.

The measurement and control of temperature is one of the subjects which pervades almost all industrial operations and on it depends the success or failure of an industry and the quality of the product. In spite of the great importance of the subject, and the advances made in it in the past few years, it has not received as much attention as it deserves as a separate subject. The American Institute of Physics is to be congratulated for having conceived the idea of such a symposium for having carried it through to its logical conclusion.

Some 125 papers representing the work of at least a similar number of authors contained in the volume have been grouped under thirteen different headings, which it may not be out of place to repeat here:

(1) Temperature and Temperature Scales. (2) Precision Thermometry. (3) Education. (4) Natural Sciences. (5) Temperature in Biology. (6) Temperature and Its Regulation in Man. (7) Automatic Temperature Regulation and Recording. (8) Special Application and Methods. (9) General Engineering. (10) Metals and Ceramic Industries. (11) Oil Industries. (12) Optical and Radiation Pyrometry. (13) Thermometric Metals and Alloys.

The papers and their discussions are followed by an Appendix containing 25 tables of useful data, a glossary giving definitions of technical terms and two very comprehensive indexes. The book is well printed, but the bulk of it suggests that it might have been conveniently split up in two separately bound volumes.

It is not possible in the course of a short review to do full justice to this comprehensive collection of papers containing the most up-to-date information on the subject. Suffice it to say that no individual or institution interested in any branch of science, pure or applied, covered by or related to those listed under the thirteen items above, can afford to miss this publication.

LAL C. VERMAN.

Air and Its Mysteries. By C. M. Botley, with a Foreword by Sir Richard Gregory. (The Book Club, London), 1940. Pp. 266. Price 2*sh.* 6*d.*

The book is not a text-book. It is intended to be of use to the lay reader in this air-minded age to enable him to appreciate some of the marvels of the atmosphere. The reader starts on his tour into the realms of the atmosphere in the first chapter on "The Ocean of Air". In the next 8 chapters he makes acquaintance with matters meteorological such as the composition of the atmosphere, the wind circulation, the clouds, the different manifestations of water vapour and its forms of precipitation, thunderstorms, the optical phenomena in the atmosphere and the science of weather and climate. A chapter on "The Realm of Sound" gives him later an idea of the properties of the atmosphere in relation to sound waves, including the interesting phenomena of the zones of silence. Then follows a chapter on "The Highways of the Air" in which the reader learns of the mechanism of the flight of birds, insects and the gliding mammals, as well as man's failures and successes with balloons, airships and aeroplanes. The last chapter "Towards the Unknown Region" opens a fascinating vista. It gives one a glimpse of the progress of knowledge about the regions in space

around the earth from the days of Wilson and Melville of Glasgow when they first raised thermometers with kites in 1749, down through the period of Glaisher, Tissandier and other pioneers, right to Piccard and Millikan. The chapter also gives the reader some idea of radio-sondes, cosmic rays, ozonosphere and the ionosphere, as well as of the enthralling manifestations of the auroras.

The style is easy, straightforward and particularly pleasant, because of the historical background, literary allusions and artistic touches that one finds interspersed in a large collection of scientific facts. The format is good; there are hardly any printing mistakes. The only two blemishes that the reviewer noticed were a mis-print of "weigth" for "weight" on page 5, and the total absence of the frontispiece of an Antarctic scene of optical phenomena referred to on page 87. The book contains 16 beautiful plates from photographs and over 20 text-figures. But the Index is not as full as one would wish.

On reading the book, one is reminded of D. Brunt's "Weather Science for Everybody" (1936) which presents meteorology, also to the lay reader, in a more formal manner. Besides the general reader, Miss Botley's book could be useful also to High School students whose curriculum may include physical geography, covering elementary meteorology. For these students, if Brunt's book were to serve as a text-book, Botley's book could form an excellent supplement for "rapid reading". V. V. SOHONI.

Practical Solution of Torsional Vibration Problems. By W. Ker Wilson. Second Edition, Volume I. (Chapman & Hall, Ltd., London), 1940. Pp. xx + 731. Price 42*sh*.

There is no doubt that at the present time Engineers are realising more and more that the study of vibration is an accompaniment of sound design. This is especially true of Torsional Vibration as it does not exhibit any external symptoms of approaching destruction, as can be usually noticed with other forms of vibration.

Since the author published the first edition of this book in 1935, considerable progress has been made in the study of torsional vibration, and this has necessitated his rewriting a major portion of the original text and adding several new chapters.

In this, the first of the two volumes of the second edition, a large amount of new practical design data has been added and high speed engine systems have been treated more comprehensively. The earlier chapters deal with the fundamentals of torsional vibration, with the calculations of natural frequency and with equivalent oscillating systems in a very thorough manner. The study of flexible couplings occupies one very large chapter, special attention being drawn to the use of rubber as a structural material in rubber-in-shear couplings under the heading "Geared Systems" considerable addition has been made and the treatment of geared engines supported on flexible mountings and of high frequency tuning as a method of solving vibration problems, are of special importance. Of particular interest also is the study of Aero engine and Air screw installations and of vibration absorbers, specially the rotating pendulum absorber which is considered to be "one of the most valuable contributions to aircraft engine design in many years". The introduction of this pendulum absorber has considerably reduced the wear on the engine parts and the operating mechanism of the variable pitch air screws.

The attempts made in recent years to assess torsional vibration stresses in resonance and to draw up reliable empirical formulæ based on test results have prompted the author to include in this volume a description of the accurate instruments which have been developed for measuring torsional vibration frequencies and amplitudes of all types of engines and installations, including the latest types of electrical measuring instruments also. The theory of these instruments is discussed in full and the methods of calibration also given.

The text is profusely illustrated with worked numerical examples and this enhances the value of the book as an aid to the designing engineer. E. K. R.

The Social Life of Animals. By W. C. Allee. (The Scientific Book Club, London), 1941. Pp. xiv + 261. Price 2*sh*. 6*d*.

This interesting book ably maintains the excellent standard set up by its predecessors, which the Club has been issuing since its inception. The book contains quite a large mass of material which will entertain and stimulate the professional biologist and the lay reader alike. Professor Allee is

well known for his investigations on the group behaviour of animals, and this is a branch of study whose fascination and general implication have recently recruited a large number of scientists trained in the analytical and statistical methods of work.

We have some exceedingly able treatises dealing with the mysteries of animal behaviour and Professor Allee's book will rank high in the series. Though the actions of animals sometimes seem easy to comprehend, the lower we go down in the scale of life, the mystery becomes almost bewildering. Have the animals the faculty of reason? How do they act with purposiveness? The answer has been "by instinct". Does the theory of *instinct* apply to man? It would appear that all animals including man behave in the generality of cases like automata, equipped with a nervous mechanism enabling them to act in a particular way in a given situation. This is the mechanistic conception or explanation of the behaviour of animals, but it is possible to demonstrate by carefully planned experiments that behaviour patterns are subject to psychological laws governing animal nature, and the possibility of endowing animals with the faculty of adjusting their actions, due to the promptings of free will, amounts to an inescapable doctrine.

For over thirty years Professor Allee has been engaged in exploring the group behaviour of animals, which formed the subject of his Norman Wait Harris lectures at North-Western University, and this book has grown out of these lectures. "I make no effort to pose as the remote purveyor of a mysterious erudition; I could not in any case regard myself as more than the exponent of the glorified common sense which I more and more firmly believe all science should be." This is modesty but it does not preclude the author from presenting to the reader a fairly comprehensive fare, rendered palatable by his lucid and amusing style. Dealing with the particular line of group organisation usually known as "peck order" in chickens, the author writes, "putting the matter somewhat facetiously, chickens appear to have developed the sort of line organization characteristic of a military system or a fascist state, while pigeons, together with the ring doves, canaries and parakeets are more democratic". He accordingly derives the hypothesis that "social organization observed in birds and other animals reminds one almost constantly of certain types of human situations ..... it may well be that the social hierarchy of chickens, canaries and men must have much in common". The reader will find that the principal thesis of the book is to reveal a gradual development of social attributes, originating in the lower animals in simple forms and culminating in coupled tendencies in the higher mammals, thus having a common substratum for all types of behaviour patterns. This extraordinarily interesting phenomenon is dealt with in six chapters commencing from the third.

This book, at once scholarly and humorous, will form an important contribution to biology, the cultural value of which can hardly be exaggerated. It is illustrated by numerous figures, diagrams and graphs, and is provided with an extensive bibliography which enhances its usefulness to students who wish to acquire more information than is provided by the book. Great care has been taken with the arrangement of the material and the effect is that the reader is offered a constructive argument and a comprehensive picture.

Sons of the Soil. *Studies of the Indian Cultivator.* Edited by W. Burns, Agricultural Commissioner with the Govt. of India. (Manager of Publications, Civil Lines, Delhi), 1941. Pp. 128 + 44 plates. Price Rs. 2–6–0 or 4*sh.*

A series of pen pictures of the different types of the Indian cultivator drawn by several authors have been brought together under the editorship of Dr. W. Burns, Agricultural Commissioner with the Government of India, and published under the above title. The types brought together are very varied and represent cultivators from many different parts of India; there is as much diversity as can be seen in the picturesque crowds of *mela* and the descriptions form both entertaining and instructive reading. Few people see the cultivator in his village and fewer still know anything of him other than as a type, half-clad, poverty-stricken, quarrelsome, insatiably fond of litigation and the law court, ignorant, immeasurably in debt, conservative to a degree, thriftless, improvident and so on. To these the book will come as an agreeable surprise, for the type is here resolved into the individual clothed in flesh and blood and seen in his

home, on his field, in the midst of his family, his oxen and his sheep, his temple, his priests, his feasts and fasts and festivals as a man with virtues to praise and weaknesses to pity, the man as apart from the "guinea stamp" and who is "the gow'd for a' that". The group is very comprehensive; there are Afridis, Pathans and Baluchis, adepts with the gun as with the plough; there are other warrior cultivators, Panjabis, Jats, Scindhis, Moslems from the U.P.; there are the men from Assam, Bengal, Bihar, Orissa; cotton cultivators from the typical cotton tracts of the Berars and Maharashtra; Madrasis and Burmans; there are men wedded to the land and there are aboriginal tribes with their shifting cultivation; there are the prosperous looking men in very consequential attire and there are men exhibiting their manly frames as God made them; bright open faces of the boy cultivators alongside the furrowed crows'-footed faces of these old "horny-handed sons of toil", showing what this ancient craft can do to the "human face divine". What kind of house does he live in, what does he eat, how much or how often, what are his clothes, his furniture, his utensils, what is his daily routine, what are his amusements, his pleasures, his domestic cares, the codes of his caste or his religion, the customs at marriages, feasts or funerals—to these and similar questions the reader will find an interesting variety of answers. Not the least entertaining part of the answers is the lore of proverbs, which so pithily sum up the hoary wisdom of the cultivator, so helpful, so amusing and so illuminating. The womenfolk come in for a goodly share of the descriptions; they are worthy helpmates as much in the field as in the home, who are often shrewder and better able to drive a bargain than the brawny male. The book is illustrated with a fine set of photographs of the different types which lend very great charm to the book. As an entertaining little book on the ways of the Indian ryot and, we may add, of his wife, the volume is a little gem.

A. K. Y.

CENTENARIES

Paracelsus (1490-1541)

PARACELSUS, a German physician, was born in Einsiedaln about 1490. His surname was Hohenheim; but he gave it up for the one of his own making. At a comparatively early age he questioned what was taught to him in Medicine by his father and struck out new ways himself. He did similarly when he entered the university of Basel. He left school chemistry and started for the mines in Tirol and preferred to learn by going to nature herself. He then went wandering over a great part of Europe. The book of nature, he affirmed, is that which the physician must read. Though others called him an ignorant vagabond, he himself valued his knowledge differently and wrote "Whence have I all my secrets, out of what writers and authors? Ask rather how the beasts have learned their arts. If nature can instruct irrational animals, can it not much more men?" He had thus acquired great stores of facts which gave him an unquestionable superiority to his contemporaries. So in 1526, on his return to Basel, he was appointed town physician and a lecturer in the University.

He broke away from tradition. His lectures were in German and not in Latin. They were expositions of his own experience and of his own methods of curing and were not commentaries on the text of Galen. For a couple of years this new venture brought him reputation and practice. But in due course jealousy and enmity gathered sufficient momentum to drive him away and he ended his life in a miserable way.

For centuries he was evaluated in every possible way. But now it is acknowledged that his vigorous attacks on the degenerate Galenism of his day helped the foundation of modern scientific medicine. His *Chirurgia magna* went through ninteen editions and translations into several languages. He is credited with the discovery of the inherited characters of syphilis. He protested against the excessive blood-letting in vogue at that time. It is claimed that he was one of the first to bid modern Europe think for a moment upon the idea that diseases are inflicted neither by saints nor demons. Thus and in several other ways Paracelsus helped the downfall of the scholastic medical science of his time.

Paracelsus died at Selzburg 24 September 1541.

De Candolle, Augustin Pyramus (1778-1841)

AUGUSTIN PYRAMUS DE CANDOLLE, a French botanist, was born at Geneva 4 February 1778. Having had his education at the college of Geneva, he went to Paris in 1796 and became a favourite pupil of the botanist, Desfortaines. In 1808 he became pro-

fessor of botany and director of Botanic Garden at Montpellier. In 1816 he resigned his offices and came to Geneva whose citizens founded a chair for him in 1817.

Histoire des plantes grasses (1799–1803) was his first book. His doctorate thesis was an *Essay on the medicinal properties of plants* (1804). He revised Lamarck's *Flora of France* (1805). His *Theorie elementaire de la botanique*, which is remarkable for its profoundness and which is regarded as his masterpiece came out in 1813. His *Regni vegetabilis systema naturale* (1818–21) had to be discontinued after the second volume as its plan was too vast for one man to execute. In 1824 began a more modest version under the title *Prodromus*. But even this had to be completed only after his death, by his son and other botanists. His *Organographic vegetale* (1827) dealt with the anatomy of plants and developed the doctrine of metamorphosis. This was followed in 1832 by a book on the physiology of plants.

While every botanist had yielded to the influence of the artificial system of Linnaeus, De Candolle was the first to estimate its merits correctly. In the principles of classification expounded by him in his introduction to Lamarck, he said "The natural method endeavours to place each individual object in the midst of those with which it possesses the greatest number of points of resemblance: the artificial has no other end than that of enabling us to recognise each individual plant. ... The former being truly a science, will serve as an immutable foundation for anatomy and physiology, to build upon; whilst the second ... does nothing towards enlarging the boundaries of science."

After a visit to a meeting of naturalists at Turin, De Candolle died 9 September 1841.

S. R. RANGANATHAN
University Library,
Madras.

SCIENCE NOTES AND NEWS

Contact Angles.—An interesting method for measuring contact angles has been described by Bikerman (*Ind. Eng. Chem.*, Anal. Edn., 1941, 13, 443) making use of the equation

$$\frac{\Delta_0^3}{v} = \frac{24 \sin^2\theta}{\pi (2 - 3\cos\theta + \cos^3\theta)}, \text{ where}$$

Δ_0 = the diameter of a minute droplet of the liquid,

v = the volume of the drop, and θ = the contact angle between air, liquid and solid.

A microsyringe is used to produce very small drops while their volume is determined by a micrometer syringe. The diameter of the contact circle is determined by measuring the diameter of the mark produced after evaporation of the liquid drops using a suitable travelling microscope. The method described, is used to measure the contact angle for water drops on built-up multilayers of soaps, on lacquered tin plate and on glass plates. The method seems to be simple as it involves the measurement of length and volume and not of the angle and the results obtained represent a more accurate average value for the contact angle. M. R. A.

Particle Size Determination by Sedimentation.—Sedimentation methods offer a means of obtaining the size distribution curves of soils. Wiegner, Kelly and others developed a simple method which consists in measuring the change in hydrostatic pressure exerted by the suspension as the suspended material separates. It was observed that the liquid from the manometer capillary entered the settling tube thereby causing a disturbance in the suspension. Kammermeyer and Binder (*Ind. Eng. Chem.*, Anal Edn., 1941, 13, 335) have improved it by using an all-glass manometer. A spoon gauge made by elongating a thin-walled bulb and then flattened on one side has been used to measure the pressure differences. The pointer movement is amplified by optical arrangements. Calibration curve is got by converting the increases in height of the liquid to increases in pressure and plotting against pointer displacements. The advantages of this method are: (1) that the final position of the pointer can be easily calculated which corresponds to complete settling, (2) disturbances caused by the flow of the liquid from the side arm are avoided and (3) a closer differentiation of particle sizes is possible owing to the high sensitiveness of the all-glass manometer. G. S.

Passivated Tinplate.—When sulphur-containing food-stuffs are packed in tin-plated cans, the insides of the cans generally become stained during the hot sterilising process. In addition, the artificial colouring matter added to certain food-stuffs get bleached by reduction by the tin. A special sulphur-resisting lacquer is often applied to the tinplate to avoid these difficulties. An alternative and simpler method of protection is described by R. Kerr in *The Tin Research Institute Publication* No. 104. This consists in passivating the tinplate with an invisible oxide film produced by treatment with a solution which is both alkaline and oxidising and contains, essentially, trisodium phosphate and sodium dichromate. Full details are given in the publication. M. A. G.

Chinese Amphibians and Reptiles.—South-eastern China has been very little explored from a herpetological point of view and for this reason the collection of Amphibians and reptiles made and described by J. L. Gressitt (*Philippine Journal of Science*, May 1941, 75, No. 1) is interesting. The collection has

been made in three provinces of south-eastern China, i.e., Kiangsi, Kwangtung and Fukien and extend over varying altitudes. The specimens fall under 63 species, including one urodele, 24 species of Anura, 6 lizards, 25 snakes and 7 turtles. In this collection has been reported one species of snake, *Natrix boulengeri* which is new to science but it includes a number of species of both amphibians and reptiles which have been taken in these provinces for the first time. No Apoda are reported from the area but one species of newt, *Pachytriton brevipes* occurs in Kwangtung province at an altitude of 640 metres in fresh-water pools and streams. It is of interest to note that a number of Indian forms occur in this part of China, notably species of *Bufo* (*B. melanostictus*), *Rana* (*R. limnocharis*), *Kaloula* (*K. pulchra*), *Microhyla* (*M. ornata*) and a number of turtles and snakes.

Chromite in Mysore.—Mysore State is one of the chief centres of chromite ore production in India. It contributes nearly one-half, and Baluchistan one-third, of the total Indian output. Mysore's total is roughly two and a half per cent. of the entire world production. In a bulletin issued for the benefit of the general public (*Mysore Geological Dept. Popular Studies No.* 2) Mr. Venugopal explains in detail the nature of occurrence, origin and distribution of chromite deposits in the State.

Workable deposits of chromite occur only in Hassan and Mysore Districts. In the former the chief productive mines are situated near Chokenhalli, Bhaktarhalli, Jambur and Byrapur on the Nuggihalli Schist belt which extends roughly from Nuggihalli to Arsikere. The Byrapur mine alone has yielded upto 1937, 60,000 tons of ore valued at Rs. 11 lakhs. In the Mysore District the only mine of importance is Shinduvalli which produces annually 2,000 tons of chromite. N. JAYARAMAN.

Substitutes for Mineral Oils.—The Board of Scientific and Industrial Research have suggested certain vegetable oils or vegetable-mineral oil mixtures as substitutes for mineral oils.

It is understood that the Inspectorate General of Stores, Cawnpore, is prepared to undertake testing of these oils. The Inspectorate is being expanded to include a Lubricant Section which, when properly equipped, will be able to undertake testing of all lubricants, including aero-engines lubricating oils required by the Defence Services. It will also test oils on behalf of the Civil Services.

The Kalabagh Barrage which is now under construction is situated on the river Indus. Its purpose is to divert water for the irrigation of the Thal area.

The catchment area of the Indus above Kalabagh is 111,900 square miles and the barrage is designed to pass a discharge of 950,000 cusecs. Sufficient freeboard is, however, provided to permit 1,100,000 cusecs to pass with safety.

There is a possibility of this discharge being experienced in the event of the Shyok glacier dam forming again and bursting simultaneously with a high flood. As a result of the bursting of the Shyok Dam in 1929 exceptionally serious floods were caused in the Punjab and the North-West Frontier Province. About 225 lives were lost and thousands of houses and head of cattle destroyed in nine districts of the Punjab. There was also loss of life and enormous destruction in some districts of the Frontier Province.

The Barrage, which is founded on a mixture of sand, shingle and boulders is designed for a maximum head of 22 feet which allows for 2 feet of retrogression downstream. It is 3,781 feet long between abutments and comprises a central weir section consisting of 42 bays of 60 feet each with an undersluice section at each end consisting of 7 bays of 60 feet each. All bays are provided with gates. The gates and gearing are being manufactured by the Central Canal Workshops at Amritsar.

The estimated cost of the Barrage is Rs. 1,75,00,000.

Forest Research Institute.—All the member mills of the Indian Paper Makers' Association have agreed to a voluntary cess of four per ton of output, based on the audited statements of the production of the mills in order to finance the researches carried out in the Paper Pulp Section of the Forest Research Institute, in the general interest of the industry. According to a report appearing in the *Indian Forester* (1941, 67, 498) a committee has been appointed to function in an advisory capacity in matters relating to research work, undertaken at the Forest Research Institute, either on its own initiative or at the instance of the member mills. At the first meeting of the Committee held at Calcutta on March 8, it was agreed that the Paper Pulp Section staff should undertake an investigation relating to the possibility of eliminating silicious scale occurring on the surface of bamboos, which appears to be unaffected by digestion or bleaching and which appears to be one of the primary causes of dirty bamboo pulp. A small technical sub-commitee was formed to consider and adopt a scheme to standardise tests and testing apparatus for paper and pulp and also to consider standards for testing the various raw materials found in India. Among other important decisions reached, mention may be made of the following: (1) a scheme in paper technology for workers in paper mills, and (2) building up a reference library at Dehra Dun for the use of those interested in the paper and pulp industry.

With a view to having closer co-operation and co-ordination between the manufacturers and research institutions, the **Indian Chemical Manufacturers' Association** has approached important Universities in India carrying on research with a request to include representatives of manufacturers of chemicals and drugs on the Advisory Boards of the Universities. It is pointed out that association of manufacturers with Advisory Boards would enable them to give their suggestions about researches that would be useful to the Industry, as it often happens that researches

are being carried out on products which are already being manufactured in the country or which could not be economically manufactured. Moreover, the manufacturers would be able to keep themselves in touch with the researches that are being carried out in the laboratories under the Universities.

Indian Central Jute Committee.—At the meeting of the Committee held on Friday, July 25, the following schemes of research were sanctioned: (1) Preparation of synthetic resins and plastics in soluble or emulsion form, suitable for impregnating bleached jute fibre with a view to improving its qualities, (2) investigations on the chemical utilisation of jute and jute waste, and (3) researches into jute fibre when treated with plastics. Experiments contemplated in this connection include the use of jute twine in the manufacture of camouflage nets, the possibility of manufacturing all-jute fabrics for canvas and other military needs.

A sub-committee was appointed in this connection, to draw up a detailed programme of work on plastics in which the respective parts that the *Board of Scientific and Industrial Research*, the *Indian Lac Research Institute* and the universities could play in this matter was to be clearly indicated. The sub-committee will consist of Sir S. S. Bhatnagar, Dr. H. K. Sen, Mr. I. G. Kennedy, Dr. W. G. Macmillan, Prof. B. C. Guha, Mr. C. R. Nodder, Mr. Padampat Singhania, Mr. Priya Nath Sen and Dr. M. N. Saha. To the same Committee was also entrusted the task of formulation of a programme of work for the Technological Research Extension Scheme.

A scheme (by Prof. B. C. Kundu) on the study of the growth and development of the jute fibre, and a scheme (by Dr. B. C. Guha) for biochemical investigations of the processes involved in the retting of jute were approved.

An important step in the progress of agricultural research on jute in Bengal was signalized by the opening of a Research Station at Konda, a village in the Brahmanbaria Sub-Division of the District of Tipperah, on the 19th August. The opening ceremony was performed by Mr. O. M. Martin, C.I.E., I.C.S., Commissioner, Chittagong Division. In the varying conditions of soil, water and climate in which the jute crop is grown in Bengal, it is necessary that agricultural research work on jute, particularly in its more practical aspects, should be decentralised and replicated at selected centres, spread over representative jute-growing areas. The research centres are intended to serve as a link between the Committee's research activities and the practical needs of the cultivators.

A Charter for Science.—The London correspondent of the *Hindu* reports: "At the Royal Institute on September 26, under the auspices of the Ministry of Information and with the support of the British Association, a world conference on science and world order will be opened.

"Explaining the object, Sir Richard Gregory, President of the British Association, said that science could be used for good or evil and the time has arrived when scientists, who themselves constituted a democracy that knew no distinctions of race, colour or creed should determine how their work should benefit, not injure humanity. The main theme of the Conference would be the use of science for constructive not destructive purposes. They hope to devise a charter to which all scientists could subscribe and reach decisions that would keep science from the hands of gangsters who used it to wreck society.

"Prof. Einstein will address the Conference by radio on 'The Common Language of Science".

Unviersity of Mysore.—A meeting of the Academic Council was held on the 30th August in Bangalore.

The following extension and special lectures were delivered during the month of August 1941: (1) Mr. A. Narayana Rao, "Some aspects of animal life". (2) Dr. R. E. Heilig, "Vitamins and preservation of health". (3) Dr. R. Balakrishna, "Industrial Development of Mysore". (4) Mr. A. V. Telang, "Separation of electric charges in the atmosphere". (5) Mr. C. V. Srinivasa Murthy, "The evolution of moral values". (6) Mr. B. Kuppuswamy Naidu, "The inheritance of mental ability". (7) Mr. R. L. Narasimhia, "Inaudible sound".

MAGNETIC NOTES

The average magnetic activity in the month of July 1941 was slightly less than that in the preceding month. There were 3 quiet days, 18 days of slight disturbance and 7 of moderate and 3 of great and very great disturbance as against 3 quiet days, 20 days of slight disturbance and 1 of moderate disturbance. The day 5th July 1941, was very considerably disturbed and the 27th the least. The character figures of individual days in July 1941 are given in the following table:—

Quiet days	Disturbed days		
	Slight	Moderate	Great and very great
19, 26 & 27	1, 2, 3, 13, 14, 15, 16, 17, 18, 20, 22, 23, 24, 25, 28, 29, 30 & 31	4, 8, 9, 10, 11, 12 & 21	5, 6 & 7

A very great magnetic storm suddenly commenced at 4 h. 59 m. G.M.T., and ended at 23½ h. on the 5th July 1941. A moderate storm occurred at 4 h. 10 m. G.M.T. on the 21st ending at 0 h. on the following day. There was one moderate storm in the corresponding month of the previous year. The mean character figure for July 1941 was 1·27 as against 0·71 in the same month of the previous year.

ASTRONOMICAL NOTES

Planets during October 1941.—Both Mercury and Venus are in the evening sky; the former will be at greatest elongation from the Sun—25° 42′ E—on October 3, but it will be difficult to see the planet on account of its low altitude at sunset. On October 27, it will be in inferior conjunction with the Sun and will afterwards become a morning star. Venus continues to be a prominent object visible for over a couple of hours in the western sky in the early part of the night. Mars will be in opposition to the Sun on October 10, and can be seen all night. It is closest to Earth on October 3, when its distance is about thirty-eight million miles and the apparent diameter of its disc 23 seconds of arc. Its apparent magnitude is −2·4, i.e., it will appear about twice as bright as Sirius, the brightest star in the heavens.

Jupiter rises about three hours after sunset and is a conspicuous object in the sky for the rest of the night. It is at one of the stationary points of the geocentric orbit on October 10, when it begins to move westwards among the stars. Saturn is in Taurus and continues its slow westward motion. It rises nearly two hours after sunset; the brightness is increasing the stellar magnitude being zero at the end of the month. Uranus will be found close by, in Taurus, about three degrees to the northeast of Saturn.

The well-known meteoric showers — the Orionids are due to appear in the latter half of the month, the approximate date of maximum display being October 22. The position of the radiant is given by R.A. 96°, Declination 15° North and the meteors of this group are characterized by swift streaks. T. P. B.

SEISMOLOGICAL NOTES

During the month of August 1941, 2 moderate and a slight earthquake shocks were recorded by the Colaba Seismographs as against 1 great, 3 moderate and 1 slight shocks recorded during the same month in 1940. Details for August 1941 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.	Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
August 1941—		H. M.	(Miles)		(Miles)	
1	Slight	09 18	1330	Near Lat. 34°·5 N., and Long. 86° E. in Tibet		
4	Slight	16 23	5780			
10	Moderate	03 48	1510	Near Lat. 10° N., and Long. 94° E. to the south of the Andamans in the Bay of Bengal		
15	Moderate	11 39	6350			
19	Slight	21 49	1710	Near Lat. 7° N., and Long. 96° E. to the east of the Nicobar Islands		
30	Slight	15 06	4810			
30	Slight	18 37	4690			
30	Slight	22 15	1430	Near Lat. 14°·5 N., and Long. 94° E. in the neighbourhood of the North Andamans		

ANNOUNCEMENTS

The tenth annual convention of the **Sugar Technologists' Association of India** will be held at the Imperial Institute of Sugar Technology, Agricultural Gardens, Cawnpore, on November 1–2.

Biological Abstracts.—Doctor Robert S. Morison, Department of Anatomy, Harward Medical School, succeeds Doctor Alexander Forbes as Editor of the *Neurophysiology* section in "*Biological Abstracts*". Dr. Ralph G. Smith, University of Michigan Medical School, is taking Dr. Erwin E. Nelson's place as Editor of the *Pharmacology* section in "*Biological Abstracts*".

* * *

We acknowledge with thanks, receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 89, No. 4588.
"Journal of Agricultural Research," Vol. 62, Nos. 4–9.
"Agricultural Gazette of New South Wales," Vol. 52, Pt. 7.
"Annals of Biochemistry and Experimental Medicine," Vol. 1, No. 2.
"Biochemical Journal," Vol. 35, No. 3.
"Contributions from Boyce Thompson Institute," Vol. 12, No. 1.
"Journal of Chemical Physics," Vol. 9, Nos. 6–7.
"Journal of the Indian Chemical Society," Vol. 18, No. 5.
"Chemical Products and Chemical News," Vol. 4, Nos. 7 and 8.
"Experiment Station Record," Vol. 84, No. 6.
"Indian Forester," Vol. 67, No. 9.
"Transactions of the Faraday Society," Vol. 37, Pt. 5.
"Review of Applied Mycology," Vol. 20, Pt. 5.
"The Indian Medical Gazette," Vol. 76, No. 8.
"The Bulletin of the American Meteorological Society," Vol. 22, No. 5.
"Journal of the Bombay Natural History Society," Vol. 42, No. 3.
"Journal of Nutrition," Vol. 21, No. 6; Vol. 22, No. 1.
"American Museum of Natural History (Journal)," Vol. 48, No. 1.
"Nature," Vol. 147, No. 3735.
"The Philippine Journal of Science," Vol. 74, No. 4.
"Indian Journal of Physics," Vol. 24, Pt. 2.
"Journal of Research," National Bureau of Standards, Vol. 26, Nos. 5–6.

Books

"The Identification of Molecular Spectra," by R. W. B. Pearse and A. G. Gaydon. (Messrs. Chapman & Hall, London), 1941. Pp. vii + 221. Price 42*sh*.
"Practical Solution of Torsional Vibration Problems," Vol. II, by W. Ker Wilson. (Messrs. Chapman & Hall, London), 1941. Pp. xxii + 694. Price 42*sh*.
"A Text-book of Intermediate Physics in Tamil," Vol. I, by R. K. Viswanathan and V. N. Ramaswamy. (Annamalai University), 1941. Pp. lxxi + 686.
"Differential Equations," by G. S. Diwan and D. S. Agashe. 1941. Pp. ix + 316.
"Annual Review of Biochemistry," edited by James Murray Luck. (Annual Reviews Inc., Stanford University, P.O. Calif.), 1941. Pp. 1 + 691. Price $5·00.
"Annual Review of Biochemical & Allied Research in India," Vol. XI for 1940. (Society of Biological Chemists, India), 1941. Pp. 173. Price Rs. 3 or 6*sh*.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences: (*Proceedings*)

August 1941. SECTION A.—P. Bhaskara Rama Murti and T. R. Seshadri: *A study of the chemical components of* Decalepis Hamiltonii (Makali Veru). *Part IV. Rasinols of* Decalepis Hamiltonii *and* Hemidesmus indicus. R. D. Desai and C. K. Mavani: *Heterocyclic compounds. Part XIV. Coumarins from* 4*-ethyl-*2*-acetylresorcinol and* β*-ketonic esters.* K. Neelakantam, P. Suryaprakasa Rao and T. R. Seshadri: *Colouring matter of the flowers of* Hibiscus cannabinus: *Constitution of cannabiscetin.* Kantilal C. Pandya and Miss Rashmi Bala Pandya: *The condensation of aldehydes with malonic acid. Part XIII. The condensation of* o-, m-, *and* p*-chloro-benzaldehydes and of* m*-bromo-benzaldehyde: The influence of groups* and comparison with Perkin's reaction. N. V. Subba Rao and J. Veerabhadra Rao: *A note on glabrin, a new component of the seeds of* Pongamia glabra. S. Rajagopalan: *Synthetical experiments in the group of sympathomimetics. Part III.* Mohammad Shabbar: *Einstein spaces admitting the lorentz group.* M. A. Wali, A. K. Khalil, R. L. Bhatia and S. S. Ahmad: *Studies in the Friedel-Crafts reaction. Part V. The effect of polar substituents on the reactivity of para-substituted phenyl succinic anhydrides with simple aromatic hydrocarbons.* D. R. Kulkarni and N. M. Shah: *The reduction of* $-CH(OH)CCl_3$ *group attached to a benzo-*α*-pyrone nucleus.* Sikhibhushan Dutt: *Pyronine dye-stuffs derived from succinic acid.* P. Kailasam: *On the cyanogen halides.* M. R. Bhimasena Rao and K. S. Gururaja Doss: *Spreading coefficients of nekal BX solutions.* Small quantities of nekal BX greatly improve the spreading qualities of oils on polar surfaces. The spreading coefficients of nekal BX solutions are found to be negative even at the highest concentrations tried. R. Norris: *A study of the Raman effect in seventeen optical glasses.* The continua that follow the exciting

line in the spectra are shown to be due to a genuine Raman effect and not a case of fluorescence. V. V. NARLIKAR: *The gravitational equations of motion in relativity.* N. S. SUBBA RAO: *The effect of sunset on atmospherics.* It is pointed out that (1) the effect of sunset on atmospherics is that of trigger action, (2) the study of atmospherics can give advance information regarding the preparation of the atmosphere for the onset of a powerful thunderstorm, and (3) prolonged atmospheric activity on the short waves appears to be connected with the formation of meteorological depressions.

SECTION B.—PROF. COL. I. FROILANO DE MELLO: *Revision of the family* Devescovinidæ, *its genera and species, with record of the Indian species of* Devescovina. G. N. RANGASWAMI AYYANGAR AND K. KUNHI KRISHNAN NAMBIAR: *Studies in* Dolichos lablab (*Roxb.*) *and* (*L.*), *the Indian field and garden bean—IV.* G. N. RANGASWAMI AYYANGAR AND N. KRISHNASWAMI: *Studies on the histology and colouration of the pericarp of the sorghum grain.* S. B. KAUSIK: *Development of the vermiform appendage in* Grevillea robusta *Gunn.* R. K. SAKSENA: *Thiamin and growth of some species of* Pythium. K. RANGASWAMY: *Cytomorphological* studies in Asteracantha longifolia *Nees.* (Hygrophila spinosa *T. And.*). V. PURI: *Studies in floral anatomy. Part I. Gynœceum constitution in the cruciferæ.* S. HIRIYANNAIYA: *A study of the vital capacity of Mysoreans.*

Indian Association for the Cultivation of Science: (*Proceedings*)

April 1941.—A. K. DAS: *The motion of gases in the Sun's atmosphere. Part III.—On the stratification of the Solar Envelope.* M. G. SASTRY: *Structure of the electronic bands of the OD molecule, Part II.* B. N. SINHA: *Magnetic Susceptibility of two-dimensional free electron gas.* K. C. KAR: *On nuclear scattering.* B. L. MATHUR: *Circumzenithal arc tangential to a corona of* 46°. BIBHA MAZUMDAR: *On the radial limitation of the solar magnetic field.* D. M. BOSE: *The use of photographic plates as an aid to cosmic ray investigations.*

Indian Chemical Society: (*Journal*)

May 1941.—AMRITANSU SEKHAR CHAKRAVARTI AND BALBHADRA PRASAD: *Apparent molal volumes of electrolyte mixtures in aqueous solution.* J. C. GHOSH, S. K. BHATTACHARYYA, M. M. DUTT AND M. J. RAO: *Iodination. Part II. Studies on the iodination of different unsaturated organic compounds in the dark in different non-polar solvents.* S. K. BHATTACHARYYA AND M. J. RAO: *Iodination. Part III. Studies on the iodination of different unsaturated organic compounds in the dark in polar solvents.* S. K. BHATTACHARYYA: *Iodination. Part IV. Studies on the photo-iodination of different unsaturated organic compounds in light of different frequencies in non-polar solvents.* S. K. BHATTACHARYYA: *Iodination. Part V. Studies on the photo-iodination of phenyl-acetylene in light of different frequencies in polar solvents.* H. D. SURI, GURCHARAN SINGH AHLUWALIA AND H. B. DUNNICLIFF: *The detection and determination of pyridine bases in denatured spirit.* PRODOSH CHANDRA RAYCHOUDHURY: *On the study of the dehydration of some pure and mixed chromiselenic alums and the formation of corresponding complex chromiselenates.* M. Q. DOJA: *The sensitisation spectra of certain cyanine dyes derived from α-picoline.* JNANENDRANATH MUKHERJEE, BARADANANDA CHATTERJEE AND AMITABHA SEN: *Variation in the electrochemical properties of silicic acid and hydrogen bentonite sols with temperature.*

June 1941.—PRIYADARANJAN RAY AND NIHAR KUMAR DUTT: *Complex compounds of biguanide with tervalent metals. Part VIII. Resolution of cobaltic* tris-*biguanide complex into its optically active enantiomerides.* PRIYADARANJAN RAY AND SUSHIL KUMAR SIDDHANTA: *Complex compounds of biguanide with tervalent metals. Part IX. Action of mercuric chloride and silver nitrate upon chromium and cobaltic tris-biguanidinium hydroxides and the constitution of biguanide metal complexes.* R. K. BAHL AND SURJIT SINGH: *The ternary system. Ammonium nitrate—ammonium sulphate—water at* 25°. SARDAR MOHAMMAD AND GANGA SINGH AHLUWALIA: *The action of hydrogen sulphide on permanganates. Part I. Calcium and silver permanganates.* P. L. NARASIMHA RAO: *Chemotherapy of bacterial infections. Part III. N¹-β-phenyl ethylsulphanilamides.* KESHO DASS JAIN AND J. B. JHA: *Adsorption of polybasic organic and inorganic acids. Discontinuities in adsorption process from solutions of sugar charcoal.* H. D. SURI, GURCHARAN SINGH AHLUWALIA AND H. B. DUNNICLIFF: *Determination of copper in country spirits.* S. V. PUNTAMBEKAR AND S. KRISHNA: *The fatty oil from the seeds of* Solanum indicum *Linn.* PRODOSH CHANDRA RAYCHOUDHURY: *Periodates of quadrivalent metals.*

Royal Asiatic Society of Bengal:

September 1, 1941.—S. L. HORA: *Races and varieties of Himalayan Mahseer:* Mahseer or the Large-scaled Barbel of India is the most famous Game Fish of the country and several books have been written on its sporting qualities. Though anglers have long been familiar with the fact that several races and varieties of this fish exist in Indian waters, the scientists, following the lead of Day, have hitherto grouped them into a single species, *Barbus tor* (Hamilton). Attempt has recently been made to study very critically the material of this species in the collection of the Zoological Survey of India with the result that at least four kinds can now be recognised from the Himalayan waters on definite morphological characters.

Meteorological Office Colloquium, Poona:

August 12, 1941.—C. G. PENDSE: *Gravity and the rotation of the earth.*

August 19, 1941.—K. NAGABHUSHANA RAO: *Saturation temperatures.*

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